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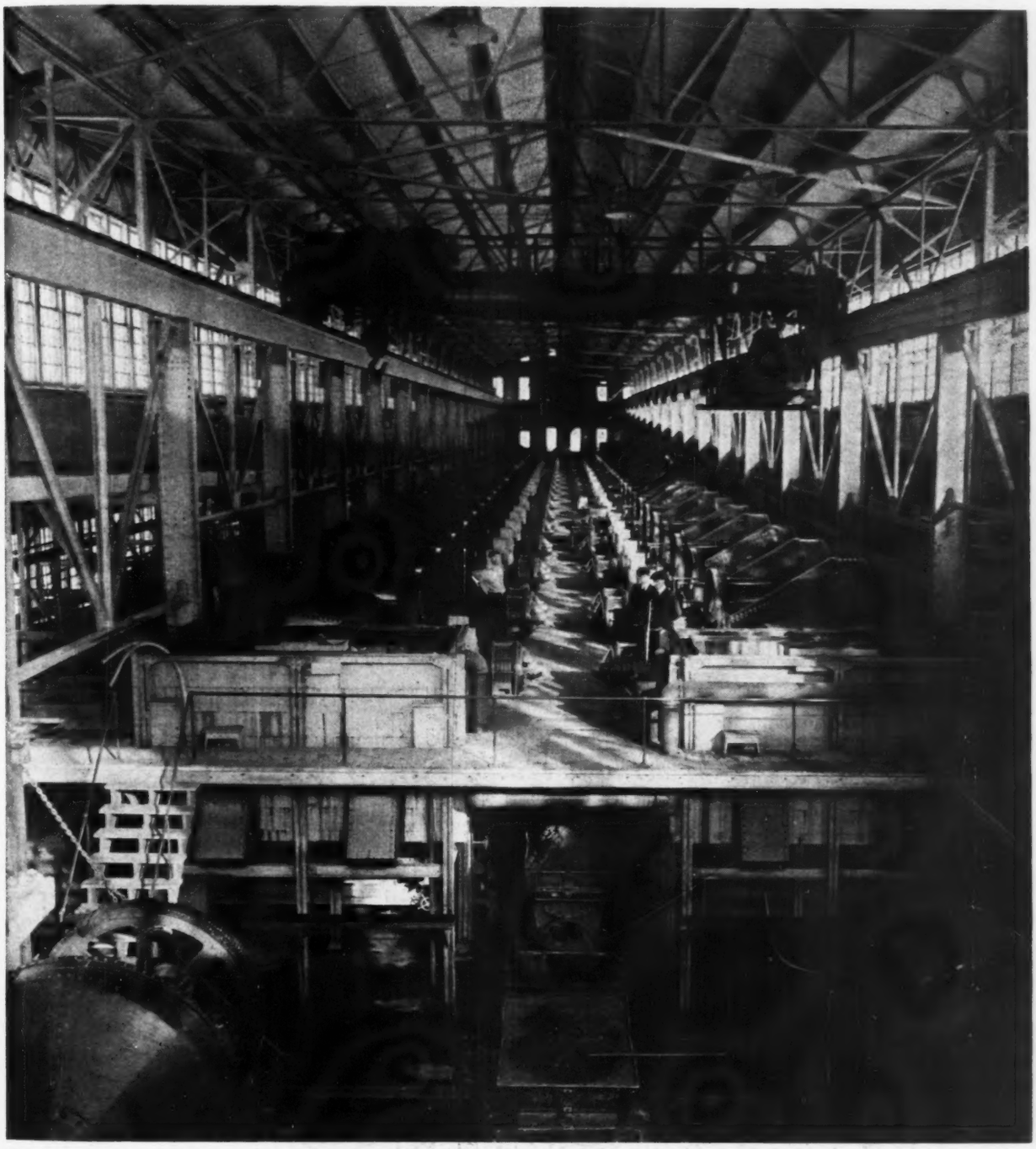
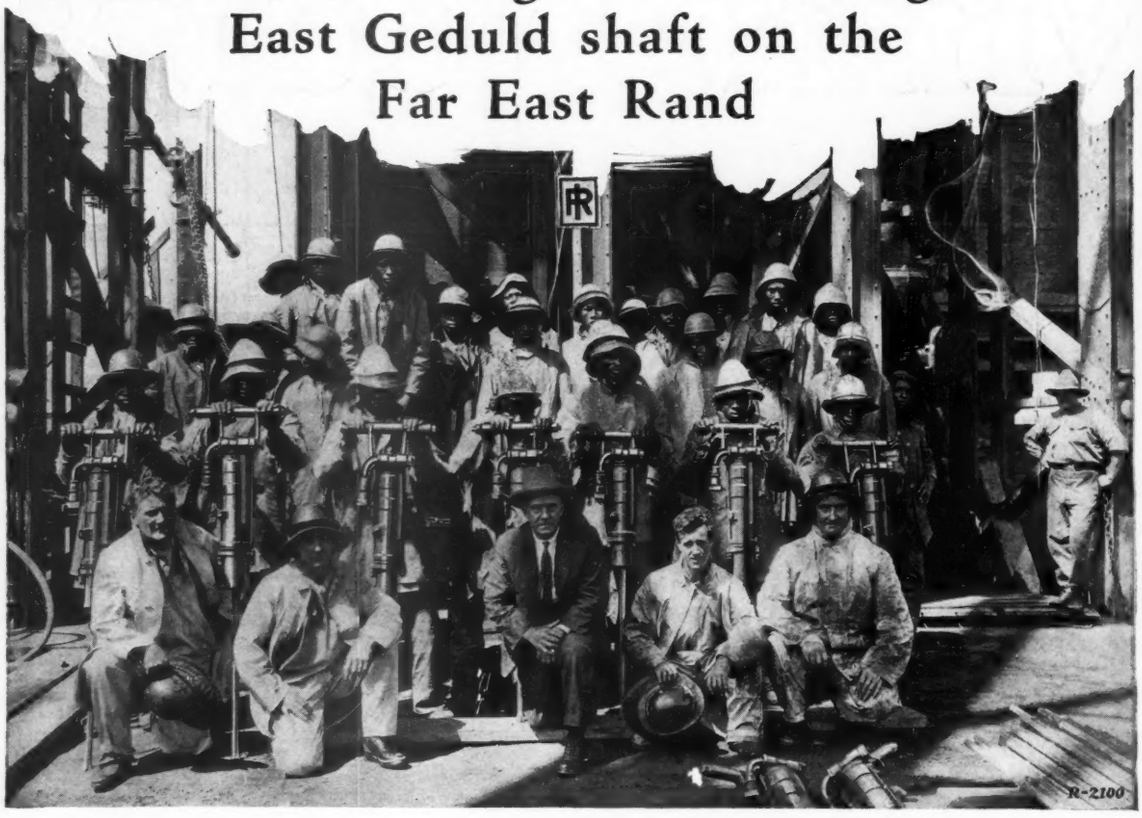


Regrinding section of Calumet & Hecla's Lake Linden reclamation plant

October 9, 1930

Remarkable Progress in sinking the East Geduld shaft on the Far East Rand



Mr. Boyd in charge of sinking

The crew pictured above is making new drilling history on the Far East Rand. Under the leadership of Mr. Boyd, who made such an excellent record in sinking the Betty shaft at the Sub Nigel, the work is progressing at a rate that far exceeds the management's early expectations.

The shaft has five compartments and is rectangular in section. All drilling is being done with Ingersoll-Rand N-75 sinker drills which are noted for their fast drilling speed and power.

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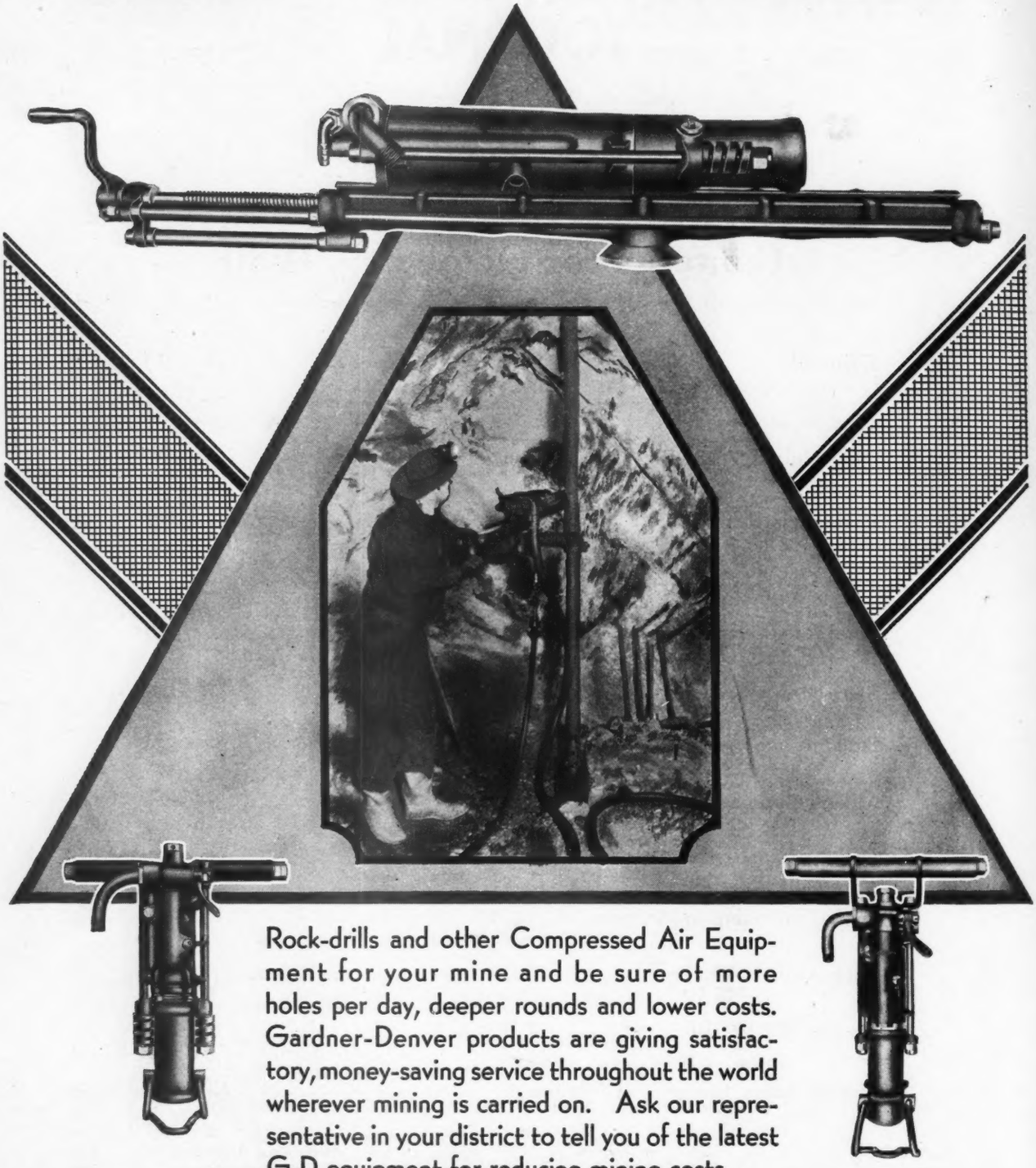

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ENGINEERING AND
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A. W. ALLEN, *Editor*

VOLUME 130, NUMBER 7

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The Cloud With a Golden Lining

NOT in many decades have conditions been so propitious as they now are for intensive prospecting and development of gold-mining properties—for the production of the yellow metal on an increasing scale. Commodity prices are low. Labor is abundant. Highly efficient equipment is to be had at short notice and at a reasonable cost. Bank deposits have shown a steady increase this year, indicating the availability for investment of money at low rates. The favorable credit terms now obtaining are not likely to change in the near future.

A shortage of gold exists throughout the world, according to many economists who see in this circumstance a restriction on commercial intercourse and one reason for the prevailing depression. Producers of gold are assured of a market for their output at a price that is fixed and satisfactory. Under competent engineering direction, the operation of a proved gold mine offers possibility for regular and steady returns on an investment, whatever the prevailing economic conditions of industry in general. Whether the world is spending or saving, at peace or at war, whether labor fails to meet or exceeds demand, gold is needed. An overproduction of gold is not within the range of reasonable prediction.

The mining of gold ore offers no difficult problem, be the deposit on the surface or underground. Metallurgical treatment is complicated only in rare instances. A marketable bullion, easily sold with negligible penalties, can be produced by small-tonnage or large-tonnage operations. No excuse can apparently be offered by the United States for its failure to increase gold production at a time when every factor is in favor of such increase. The ore is here. Capital for exploration and research and production is available. Technical skill was never more eager to demonstrate its ability. Engineering is ready to work miracles of economy in the production of power and in the handling of material.

Opportunity beckons to the entire metal-mining field —to aid in counteracting the effects of depression in metals other than gold. If engineers are courageous without being unprofessional, if buyers of prospects are fair, and sellers are reasonable in their demands, a national movement to increase the production of gold, which would be of material help to industry in general, should soon be under way.

The United States is a land of immense low-grade ore resources; but its gold-mining industry, since the development of the Witwatersrand and other large fields, has seemed to lag behind the domestic copper industry, for example, in technical initiative and achievement. The yield of gold in 1928 was $46,165,000; in 1929, it had dropped to $43,900,000. This trend can and should be reversed. Which company or group of operators, or which state in the Union, will be the first to record a material increase in production of gold—in that branch of the mining industry in which the Chief Executive of the nation served an apprenticeship; and which now offers opportunities markedly more favorable than have existed for a generation?

New Uses for Metals as Metallic Compounds

IN AN ADDRESS to the Steel Institute, Mr. Charles M. Schwab made the statement that new uses for steel are constantly being found, and that large, unexplored fields lie ahead. Tonnages for the increasing capacity of the industry, he averred, should not be expected to come entirely from existing sources, but may be found by extending the use of steel in new fields. An interesting new application is now being witnessed in the first road of steel, under construction in Illinois. It has a base of rolled steel, with a cushion of mastic sand and a surface of three-inch brick, offering a smooth top, with flexibility to meet all changes in temperature without breaking or cracking.

Producers of non-ferrous metals are also aware of the necessity of finding new outlets for their products. Spectacular developments, as witnessed in the steel industry, may not be possible; but, on a comparative basis, opportunities are equally great or even greater. In this effort the smaller opportunities should not be overlooked. A recent report from the Federal Bureau of Fisheries discloses the interesting fact that copper sulphate can be used with great advantage in oyster farming. Minute quantities of copper in the water have been found of importance in the process of attachment or setting, which must be successfully completed for the survival of the young oyster. Furthermore, in an effort to find some chemical that would be effective and practicable for the elimination from the oyster beds of starfish—the worst enemy of the oyster—copper sulphate has been found to meet requirements. This salt may be dragged over the oyster beds in bags at the beginning of the flood tide, and as little as fifteen ounces in 2,000 gallons of water will kill the adult starfish after a few minutes' exposure. Small starfish are killed by exposure to solution containing twelve to sixteen ounces in 10,000 gallons of water. Interesting is the fact that the sulphate is not toxic to the oyster and marine fish. It is soon completely precipitated from the sea water.

The useful qualities of copper sulphate as an exter-

minator have been known for a long time. It has found wide application in combating pests in vineyards, and is used extensively in water-works to prevent the growth of certain algæ that cause rapid deterioration. Copper oleate is used for "curing" fishing nets, and for impregnating them so that the unwelcome attention of marine pests, not affected by the coat of tar usually employed, is discouraged. It has also been found useful for the prevention of mold. Addition of three per cent of copper sulphate to asphalt decreases its tendency to "run" at elevated atmospheric temperatures. In selective flotation copper sulphate has become an important addition agent. It is superior to common salt as a component of the mixture surrounding copper ground-plates.

The few sometimes unexpected applications of metallic compounds in industry here recorded indicate the wide field of usefulness which may be developed through intelligent research and investigation. Mr. Schwab's vision of large, unexplored fields lying ahead does not apply exclusively to the steel industry.

Rope Tramways for Passenger Transportation

ROPE TRAMWAYS have generally been considered by the mining industry as applicable mainly for the hauling of ore. Attention may well be directed to the progress that has been made in the design of the equipment and in the construction of special cabs for the freighting of passengers and of supplies.

One passenger ropeway in India covers a distance of fifteen miles; another in Colombia, for the same purpose, is forty-seven kilometers long. Still another, of nearly the same length, carries upward of 200,000 passengers per annum, in addition to general merchandise. The construction of such ropeways is similar to that of the ordinary ore-carrying lines, with added emphasis on safety and security. In discussing this development, Mr. Harrison Roe, an engineering authority on wire-rope tramways, maintains that "The opinion is held in responsible quarters that, if equal care is given to the operation of a ropeway as is given to a passenger-carrying railway, passengers can be carried with as great a degree of safety on a ropeway as on a railway. This," he concludes, "is a new development in this branch of engineering."

The wide use of the rope tramway in South America, particularly in the utilization of its passenger-carrying advantages, is due largely to the rugged topography of many regions there and to the object lesson of safety, speed, and comfort demonstrated to visitors to Rio de Janeiro by the rope tramway that carries tourists from the mainland to the top of an island peak in the harbor, from which they can obtain one of the most beautiful panoramic views in the world. Many long and weary journeys on muleback to distant mining properties might be avoided if travel were possible "as the crow flies." The airplane is serving a useful purpose, especially in the pioneering stages of many mining ventures. For steady transportation of men and supplies, and for the freighting of products and ore from mine to coast or rail head, however, the rope tramway possesses advantages that have not been fully realized.

Careful Metallurgy Means Successful Marketing

EXCEPTIONAL grade or purity of a non-metallic or a metal product may effect a reduction in sales resistance and an increase in acceptance. This is illustrated by the experience of the Nevada-Massachusetts Company, which produces from its Nevada properties a scheelite concentrate of a grade that not only commands a premium but also occupies the preferred position in marketing.

A bulk concentrate is produced by tabling, but this by itself could be marketed only at considerable sacrifice. It is first subjected to magnetic separation, to remove the naturally magnetic minerals. Then it is given a flash roast, and the magnetized pyrite removed. This reduces the iron content and increases the grade. By giving the final product a complete roast, sulphur is reduced to a maximum of three-quarters of one per cent. The four additional steps after tabling result in a product of an average shipping grade of seventy per cent tungsten trioxide. Before roasting and subsequent treatment the concentrates contain about forty-two per cent tungstic acid. On the basis of seventy per cent tungstic acid, the finished product represents a content of about eighty-seven per cent scheelite.

The availability of standardized products of high grade simplifies subsequent process work and insures the reliability of the end products. This applies generally to the non-metallic field. The rewards for conscientious and successful grading and cleaning include easier marketing and repeat orders.

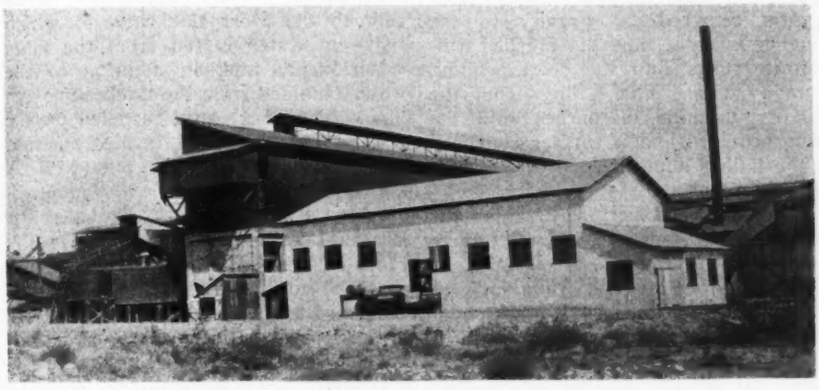
Bureau Publications Reach High Plane

COMMENDATION is in order in appreciation of the quality of the publications recently issued by the United States Bureau of Mines. A striking example of the initiative of its officials is the large multicolored map just off the press, giving the production in 1928 of metallic ores in the United States, supplemented by detailed statistical data. A demand will assuredly arise for yearly and up-to-date editions of this map.

The director of the Bureau, Mr. Scott Turner, in a recent address in the Middle West, drew attention to the papers on mining and milling methods and costs now being issued, which he said were indicative of the generosity and co-operation of the engineers of the industry. He was justified in pointing with pride to this innovation. The monographs are unusually complete and helpful, each indicating the possession by the author of an intimate knowledge of the subject, and conscientious work by the editor. *Engineering and Mining Journal* only regrets that the number and length of these papers make reprinting, or even abstracting, an impossibility. Those who are interested in mining and milling operations are recommended to avail themselves of an opportunity to acquire what constitutes a library of information on these subjects. Thus will the profession indicate its appreciation of the fine work being done by Mr. Turner and his staff in securing and publishing material of such a high standard. The authors of the papers, who are operating engineers, may thus be encouraged to write further for publication, for the mutual benefit of themselves and the fraternity.

United Verde Extension's New Concentrator at Clemenceau

J. B. Huttl
Assistant Editor



General view of concentrator

CONDITIONS have been considerably improved at the United Verde Extension Mining Company's smelter at Clemenceau, Ariz., as a result of building a 200-ton flotation unit to reject excess gangue material from the more siliceous low-grade sulphide ores prior to smelting. The concentrates produced contain most of the iron content of the ore; and, consequently, when added to the reverberatory charge, they materially reduce the amount of barren flux needed.

The new concentrator, designed and constructed under the direction of R. E. Leisk, of the United Verde Extension staff, with the co-operation of J. C. Salisbury, smelter superintendent, and E. L. Sweeney, consulting engineer, was placed in operation the latter part of July. It is one of the best examples of the compactness with which the modern flotation plant can be constructed, compared with the old concentrating plants. Several unique features are embodied in its construction, the most interesting of which are, first, the taking advantage of available smelter equipment for crushing, sampling, storing, and transporting the mill ore, thus making the mill an intimate unit of the smelter; and, second, the admirable way in which the problem of gravity flow was solved, the mill being constructed on a flat site. Both features are illustrated in the accompanying flow sheet and in Fig. 1.

All milling ore is hauled to the smelter receiving bins in 30-ton cars from the 1,300 loading station through the Josephine tunnel, the portal of which is about three miles from the smelter. It is then passed through the crushing and sampling plant, to be reduced to ½ in., and is conveyed by a belt conveyor and movable tripper to and deposited into the two storage pockets of the concrete smelter bedding bins. The pockets, with a storage capacity of 1,000 tons, are equipped with four Hammill automatic feeders, which feed the ore evenly onto a short horizontal belt conveyor. From this point the ore is conveyed and discharged onto an incline conveyor, which in turn transports and feeds it evenly to a No. 75 Marcy ball mill. The latter, driven by a 150-hp. Westinghouse motor, in closed circuit with an 8x25-ft. Dorr classifier, reduces the ½-in. material to about 73 per cent minus-200 mesh.

Lime, about 1.8 lb. per ton, to keep the circuit definitely alkaline, is fed to

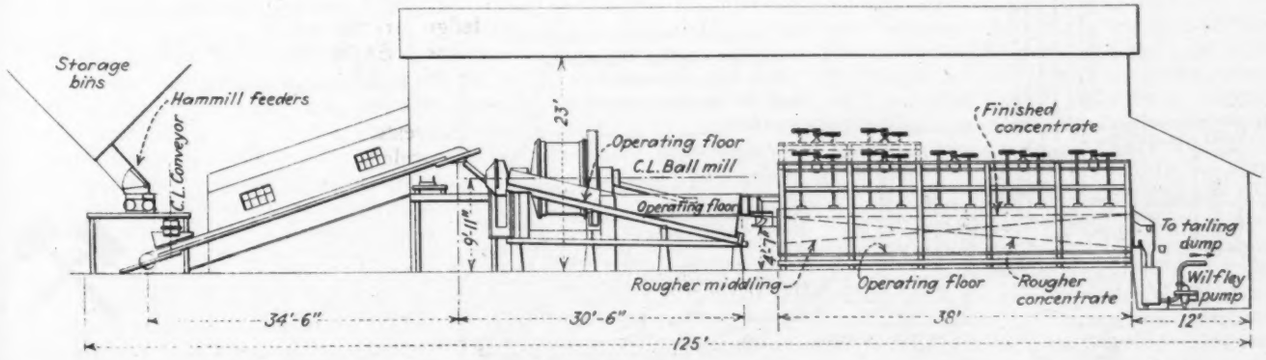
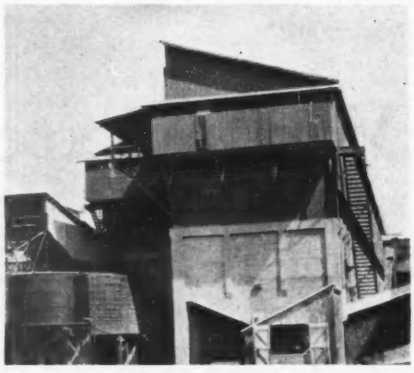


Fig. 1—Mill assembly elevation

the charge by an automatic feeder installed at the meeting points of the horizontal and inclined conveyor. Four-inch balls are used exclusively for charging the mill, the consumption being about 2½ lb. per ton. A ten-cell Denver Sub-A rougher and a four-cell Denver Sub-A cleaner machine comprise the flotation department. The former is equipped with five and the latter with two 10-hp. Allis-Chalmers motors, fitted with Texrope drives to rotate the 21-in. diameter impellers. Experiments are being conducted with amyl and ethyl xanthate and cresylic acid, but the exact reagents to be used had not been determined at the time of writing.

The pump equipment at Clemenceau is of particular interest because of its flexibility. It consists of a large concrete tailing sump, divided into two sections, each of which is equipped with an individual discharge connection; three smaller sumps, also of concrete construction, one of which is continuously kept as a spare and the remaining two used as storage tanks for the rough and finished concentrates; and three 2-in. and two 3-in. Wilfley pumps, the former being driven by a 7½-hp. and the latter by a 15-hp. motor. All pumps are fitted with special bypasses and valves to enable the mill operator to use one or the other as a spare in case of a pump failure.

Overflow from the Dorr classifier is discharged into the ten-cell rougher machine through a wooden launder. Finished concentrate, produced in the first five cells of the flotation machine, flows by gravity through a wooden launder to the corresponding storage sump. The product of the five remaining cells is discharged and collected in the rough-concentrate sump, from which point it is pumped by one of the three 2-in. Wilfley pumps into the four-cell cleaner machine, of which two cells produce finished concentrate in closed circuit



Bedding bins, thickener, and mill-water supply tank

with the remaining two. Cleaner tailing is returned by gravity to the rougher machine, and the finished concentrate flows into the corresponding storage sump. The tailing from the rougher machine discharges into the sump provided and is further conveyed to the tailing dump by one of the 3-in. Wilfley pumps.

All sampling is performed automatically. Scobey samplers, adjusted to take a sample every 15 min., are installed at the rougher head and rougher and cleaner ends. From the storage sump the finished concentrate is pumped to a 40x10-ft. Dorr thickener, where thickening and dewatering take place. Because of the low ratio of concentration, about 40 per cent of water is recovered from the thickener overflow, which is returned by gravity to the mill-supply tank. The thickened concentrate is then pumped, by a Dorr diaphragm pump, to a 4x10-ft. Dorr thickener for final treatment. The dried filter cake drops into a louvre-bottomed surge bin, installed above the belt conveyor provided for conveying the roaster charge from the bedding bins to the roasters. Thus, the concentrate can be added directly to the charge with little labor and whenever desired.

The mill building proper is a wood-frame structure, covered with corrugated-iron sheets. To facilitate repair work on the installed machinery and the transportation of materials such as mill liners and balls with a minimum amount of manual labor, trolley beams are installed at various strategic points. Water for mill operations is obtained from the mill-water supply tank, adjacent to the Dorr thickener, to which make-up water is fed from the main water-supply tank in addition to the water obtained from the thickener overflow. The float valve, installed on the water-supply pipe line, insures an even water level and constant pressure. A high-pressure water line, with the necessary connections, is also provided for cleaning purposes and for use in the event of fire. All machinery was purchased from the Mine & Smelter Supply Company, and its prompt delivery helped to make possible the erection of the mill in the record time of three months.

Grateful acknowledgment is made to George Kingdon, general manager, for permission to publish this article, and to J. C. Salisbury and R. E. Leisk, smelter superintendent and assistant mine superintendent, respectively, for their co-operation.

Metallurgical Data for August, 1930

	Per Cent Water	Dry Tons	Ounces Silver	Ounces Gold	Per Cent Copper	Per Cent "Insoluble"	Per Cent Iron	Per Cent Sulphur
Feed	4.4	6,350	0.049	0.94	4.58	57.8	13.9	14.8
Concentrate	10.9	2,471	0.104	1.90	11.18	13.0	28.9	37.6
Tailing	....	3,879	0.011	0.32	0.38	86.5	4.4	0.3
Recovery, per cent	....	.....	85.66	78.91	94.99	....	....	....

Ratio of concentration: 2.57 to 1.
Per cent solids in flotation feed: 30.

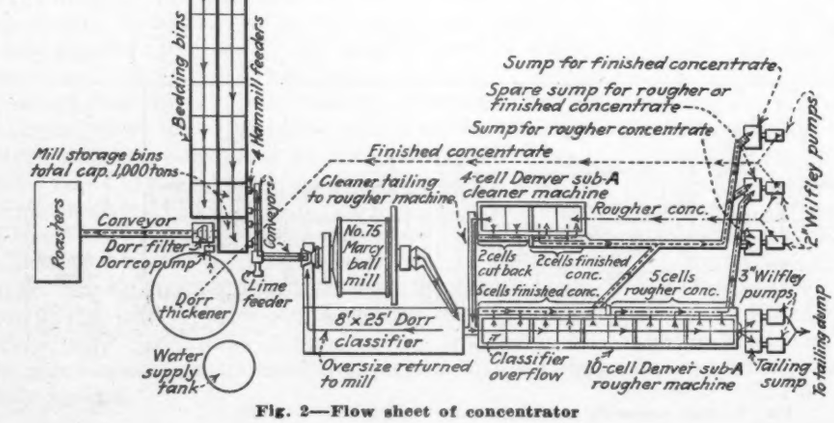


Fig. 2—Flow sheet of concentrator

Reagents Used per Dry Ton of Ore Milled

	Pounds
Ethyl xanthate	0.238
Amyl xanthate	0.178
Cresylic acid	0.271
Burnt lime	2.16

Balls (pounds) used per dry ton of ore milled, 292

Kilowatt-hours per dry ton of ore milled, 20.69

Days' running time: 30.79

Crystalline Talc

Operations in California of the Pacific Coast Talc Company

THIS interesting account of a successful enterprise indicates the value of developing an efficient technique of processing and control, resulting in standard products of high quality. Not content with mere production, however, it has sought new markets and gained them. In applying science, engineering, and good management, it can compete successfully with imported products, which are admitted to the United States duty free.

Frank R. Wicks

Consulting Mining and Industrial Engineer, Los Angeles, Calif.

TALC, a product of desert mining, is perhaps one of the most widely used of the natural, nonmetallic minerals. In powdered form, in various grades and mixtures, talc is required in a great variety of industries. It is an essential ingredient in many of the most generally used drug supplies and cosmetics.

Pure talc is a white and rather soft mineral having a distinctly smooth, velvet-like feel and a pearly luster. Chemically pure talc is a crystalline, hydrous magnesium silicate, one of the most inert or inactive chemical combinations known in nature. This chemical stability adds much to the utility of talc in many manufacturing processes. The associated mineral, tremolite, an anhydrous calcium-magnesium silicate, also white and crystalline, has many of the desirable attributes of talc.

One of the most interesting and extensive deposits of white talc in the United States is found in the northeasterly portion of San Bernardino County, Calif, about 7 miles northeasterly from the old desert town of Silver Lake, on the Tonopah & Tidewater Railroad, and about 10 miles north of the Arrowhead Highway. This is believed to be the only workable deposit of crystalline talc on the North American continent. The property is operated by the Pacific Coast Talc Company, under the management of George Ames, of Los Angeles. It has been a continuous producer of both crystalline talc and tremolite for over ten years and was operated intermittently for several years prior to that time. The products are marketed under the trade name "Silver," derived from the near-by Silver Lake, which is the sink of the Mojave River and other intermittent desert streams.

Structurally, the talc and tremolite occur together as a large vein, which has a strike of 75 to 80 deg. east, and an average dip of 55 to 60 deg. south. Granite predominates as a footwall rock. Granodiorite and pegmatite are the chief hanging-wall rocks. There is an occasional showing of serpentine. The vein consists of a series of huge lenses connected by relatively short and narrow stringers of talc. The lenses have no regularity as to location or dimensions, but are often 75 to 100 ft. in length and height and have thicknesses up to 8 or 10 ft. Extensive faulting has occurred during and subsequent to the formation of the lenses, with the result that the vein seems to double upon itself both horizontally and vertically, to the extent that one lens may partly overlap another with a rib of waste rock between. This sometimes produces the appearance of two veins, separated by three or four feet of diorite or pegmatite, but having an aggregate width of 18 to 20 ft. of talc.

The average mining width of the whole vein is estimated at 5 to 6 ft., but as the work progresses there is a definite tendency for the vein to widen with increased depth. Whether or not this gradual increase in width will continue below the present lowest workings remains to be seen. In some places the full width of the vein is clean talc, whereas other places show a band of tremolite alongside of the talc occupying as much as half of the total width of the vein, with an occasional thin streak of silica or silicified limestone along the footwall. In any case the inclosing walls are hard and tight and are frequently slickensided by fault movement, so that it is easily possible to mine either talc or tremolite separately and without contamination from waste rock. The relative softness of the white minerals is an important factor in this respect, as only light blasting is required.

The entire deposit is probably the result of complete or partial alteration of tremolite, which in turn had its origin in either serpentine or olivine. These geologic changes seem to have resulted from intense structural pressure at relatively moderate temperatures and accompanied by sufficient water vapor to permit the hydration of the talc mineral. The proportion of unaltered tremolite in the vein seems to be less with increasing depth below the surface. Throughout the deposit the talc shows the distinct crystalline structure so noticable in tremolite, but the talc crystals are much smaller and softer than the crystals of the parent rock. Under the microscope the tremolite crystals are seen to be oblique prisms, while the talc prism has a right-angle base.

Mining operations are conducted through a main tunnel, now about 2,000 ft. long, which will ultimately reach a length of over a mile. This tunnel connects with the old main shaft at a point 220 ft. below the surface. The shaft, not used during the past five years, is now being extended 150 ft. below the tunnel level, on the incline of the vein, in preparation for deeper mining. Above the main tunnel several of the stopes have extended through to the surface, about 200 ft. as an average. These now furnish sufficient ventilation for the workings. The mine is dry throughout, which is a great advantage in handling this mineral.

Between the various lenses of talc and tremolite are sections of the vein where the width of the talc is insufficient for profitable mining. As these portions serve for supporting the hanging wall, the amount of mine timber required is thus limited to only a few heavy stulls, an occasional tunnel set, and the supports for chutes in the principal stopes. For convenience in mining and to prevent the ultimate development of heavy ground pressure, most of the old stopes adjacent to the main haulageway are refilled with waste from exploratory work. The main shaft is equipped with

a Fairbanks Morse single-drum hoisting engine. This is not now used, but will be again required for deeper mining. Small Sullivan air hoists, set on the tunnel level, are being used for development work below the tunnel. Two winzes, about 500 ft. apart, have been sunk 125 ft. below the tunnel, and both are in talc of mining width all the way down.

All the talc, which is given a preliminary sorting as mined, is trammed out through the tunnel in one-ton cars. Bins at the surface are arranged for separate storage of the various grades, each bin having a capacity of 50 to 60 tons. From the bins the talc is drawn into trucks for hauling to the railroad, each grade being shipped separately. The shipping point is known as Talc Station, on the Tonopah & Tidewater Railroad, which connects with the Union Pacific at Crucero, and with the Santa Fe at Ludlow, Calif., thus affording choice of routes to Los Angeles.

The truck road distance from the mines to Talc Station is 6 miles, straight across a sloping alluvial plain adjacent to Silver Lake. By constant dragging with a light steel road drag chained behind the truck, the road is kept in such condition that 13 to 14 tons can be hauled per trip on a six-wheel White truck. The truck with this load coasts at fairly good speed from the loading bins to within about a mile of the railroad siding, before any power is required. This is interesting because the cost of hauling has thus been reduced to 11c. per ton-mile, including depreciation charges on the truck, and also including the cost of road work, loading and unloading talc, and the back haul of water and fuel for the mines. The cost per truck trip is now about the same as for the four-wheel truck formerly used, which hauled 6 tons per trip, over what was considered a good average road to the same station.

Crude talc and tremolite are shipped in box cars to the grinding plant of the Pacific Coast Talc Company, at 2149 Bay St., Los Angeles. No talc is sold in the crude form, principally because the proper selection and preparation of talcs for various specific uses are important, and require skill and experience to accomplish uniform grading and grinding. The principal equipment in the Los Angeles plant consists of a No. 2½ Wheeling crusher and a five-roller, high-side, Raymond impact pulverizing mill, with air-float arrangement. There is also such accessory equipment as is required for conveying, sorting, elevating, screening, sacking, and storing. Means are also provided for making such physical and chemical tests as are necessary for correct grading and sizing of the talc.

The plant has floor space for storage of more than one thousand tons of sacked material, and sufficient trackage to permit the simultaneous loading or unloading of three railroad cars, as well as facilities for truck loading for local and harbor shipments. Thus immediate shipment of carload lots of almost any grade or size can usually be made from stock when desired. The talc and talc-tremolite mixtures are made up in five standard grades, each being for certain specific purposes, and each ground to a certain predetermined fineness which has been found most suitable for that use.

All grades are packed in 100-, 125-, and 200-lb. bags, either with or without paper liners, as the market requires. The plant is equipped to pack in wooden barrels or in paper bags on special order. Jute bags with paper liners are used for all ocean shipments and for all talc to be used in the cosmetic and drug trades. Cotton bags have been the most satisfactory for the greater part of the local business. The standard of fineness for most uses of talc is the 200-mesh screen, and the principal portion of the grinding is 99.5 to 99.7 per cent through this screen. Coarser grinding is standardized at 75, 90, and 95 per cent through 200 mesh, and finer grinding by similar percentages through a 325-mesh screen.

Accurate control of the fineness of grinding is essential for the production of uniform products, and this has been thoroughly worked out. The fineness is checked by screen tests and by microscopic measurement when necessary. In this way it is possible to make reasonably accurate measurement of grain sizes down to 0.001 in., or 0.025 mm. In some instances it is important to know the proportion of various sizes finer than a given mesh, as well as to determine the size of the largest particles. For this purpose the microscope has proven very useful.

The chemical quality of the talc is determined by quick acid tests, made every hour or oftener if necessary, supplemented by more detailed analyses of car-lot quantities. Color tests are made frequently, by comparison with established standards which are rigidly adhered to in classifying different grades of talc. In these tests it is of interest to note the accuracy of color perception developed by men in the plant, who become so experienced that they can detect color variation in products that seem absolutely white to the untrained eye. Other physical tests are made at frequent intervals to insure freedom from grit or other undesirable elements in the various grades where such matters are important factors. Unusual care is exercised at the mines and in the transportation and handling at the plant, to insure absolute cleanliness of all products.

For the manufacture of cosmetics and talcum powders, and for use in the drug trades, a very white, selected talc is furnished, packed in paper-lined bags. The paper liner is closed securely and the bag is then sewed so that no possible contamination can occur, either by absorption of odors or vapors during shipment, or by the sifting in of foreign materials. This talc must be of such quality that it does not contain grit or acid-soluble materials, and that it does not cause the skin to become shiny or glossy when applied to the face, and it must have the proper capacity to absorb and hold perfumes.

Crystalline talc and talc-tremolite mixtures find extensive use in the ceramic industry for the manufacture of white tile of various kinds and for wall and floor tile, both glazed and unglazed. Certain of these uses are covered by patents. In most ceramic work the talc is used in combination with small amounts of plastic clay. For the production of white ware, the color and texture of the talc materials is important. Fineness of grinding must be accurately controlled. When properly prepared and compounded, the crystalline talc can be fired with practically no shrinkage or warping, and the ware is of such texture as to take and hold a good glaze. It is also said to have good dielectric strength, and thus is much used in making electrical porcelains.

In the manufacture of rubber products of many kinds the crystalline talc is extensively used, not only for the dusting of molds and finished goods, but sometimes incorporated in the product itself. Automobile tires and tubes require the greater proportion of the total used in this industry. Some rubber manufacturers prefer a grade of talc not so intensely white as that required in other trades.

On account of the smoothness of powdered crystalline talc, it serves as an important ingredient in many dry lubricants and heavy oil lubricants. The lubricating quality or property of the dry powder is also utilized in foundry molding, in handling timber, and many other ways.

One of the most interesting developments accomplished by the technical staff of the Pacific Coast Talc Company is the production of Silver Crystalline Talc concrete admixture, for use in portland-cement concrete. This product was placed on the market four years ago, after about two years of testing and investigation, and has now come into general use in the better class of concrete work. The crystalline talc selected for this particular use possesses three properties which seem essential to a successful concrete admixture. It is chemically inert, has excellent lubricating qualities, and is highly water resistant. The Silver talc admixture is used in proportions of about 3 lb. per sack of cement, or 12 to 18 lb. per cubic

yard of concrete, replacing about an equal weight of water in the mix. It serves to produce a workable, plastic mixture and tends to reduce or prevent segregation of the component parts by increasing the pasty condition of the mix. Its use aids in procuring high-strength concrete and in insuring a uniformly smooth exterior where the concrete is to be left exposed. It has been incorporated in concrete throughout some of the largest buildings in the West. In the manufacture of this product, also, the character of the grinding is fully as important as the selection of the correct crude materials.

Among the miscellaneous uses found for talc, particularly that of the crystalline variety such as the Silver talcs, the manufacture of paper products and paint are worthy of special mention. These industries have gradually increased the use of white talcs in place of the darker soapstone materials. Even in the colored products—such as building paper, roofing paper, and composition roofing and in cardboard products—the crystalline talc seems to be well liked.

The Pacific Coast Talc Company does not purchase or handle talcs other than those produced at the Silver Lake mines; but at the Los Angeles plant the company handles a limited tonnage of other white, non-metallic minerals, such as whiting, mica-schist, and bentonite clays, principally for the convenience of car-lot purchasers of talcs who also use smaller amounts of other natural materials.

The successful production and marketing of talc involves many of the usual problems of mining and processing such as are encountered in metal mining, plus the intricate control of dry, air-float grinding, and the talc business also involves a more or less detailed study of the various industries in which talcs find application.

As the talc industry has no tariff protection, the crystalline talc of California must compete on a cost and quality basis with Canadian talc and with the talcs produced in several European countries. Such competition can only be met by maintenance of uniformly high quality and by the most rigid economies in production and sales costs. The mining and marketing of talc should not be undertaken by anyone without prior experience in the particular trades to which the talc is sold as well as the ordinary experience of non-metallic mining.

How An Efficient SUPPLY CAR Was Designed and Constructed

INTELLIGENT transportation of materials means low haulage cost. In other words, materials must be delivered from the collar of a shaft to the point where they are required underground with the least possible amount of loading and unloading. This applies particularly to the two most important items needed underground—timber and steel. At many properties, a direct delivery of these materials to the timber or machine man is impossible because of lack of suitable supply cars, necessitating a frequent unloading and reloading of the materials at the various underground stations, with consequent loss of time and increased costs.

The mining department of the Copper Queen Branch of Phelps Dodge Corporation, at Bisbee, Ariz., has satisfactorily overcome this difficulty by the use of a special supply car, designed by J. W. Scott, general mine foreman, details of which are shown in Fig. 1. The car proper consists of the body, made of 5-in. channel, 2½ and 3-in. angle iron, and ¼-in. plate, reinforced with 2-in. angles and ¼x2-in. bars, and a standard mine car truck. The drawbar and coupling at each end of the car permit its attachment to any ore train or locomotive underground or above, and four collapsible guides are provided to secure the load. Two hanger rings bolted to the front end, and two roller wheels on the rear end, spaced according to the gage of the track, facilitate the placing of the loaded car lengthwise into the skip at the collar of the shaft, and its unloading at any underground station—two simple and mechanical operations. The two hanger rings are first placed into the two hooks provided at the head of the skip, which is then raised slowly until the car rolls by gravity into its proper position. To insure stability of the loaded car within the skip, the lower end of the car is automatically locked by a locking device or bear trap, which is bolted to the floor of the skip, as illustrated in Fig. 2. Underground, its removal is equally simple. By pressing the foot lever of the lock mechanism the lower end of the car is released and can, with little effort, be placed first upon the two roller wheels and then on its truck while slowly lowering the skip. The car is then attached to a train or locomotive, and, with its load undisturbed, is delivered to the point where it is required.

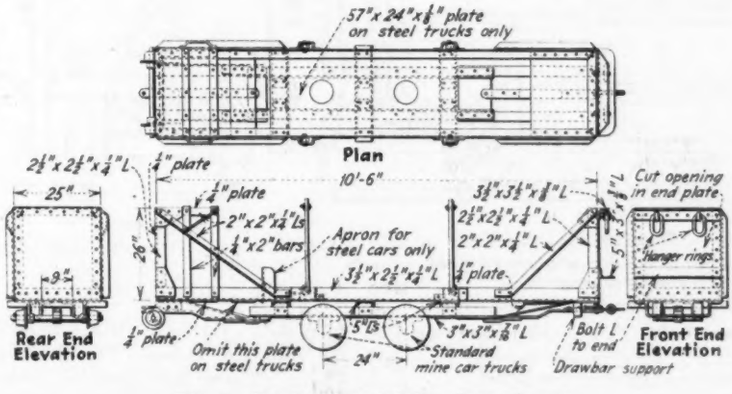
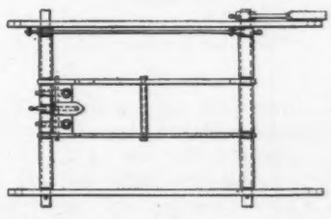


Fig. 1—Construction details of supply car



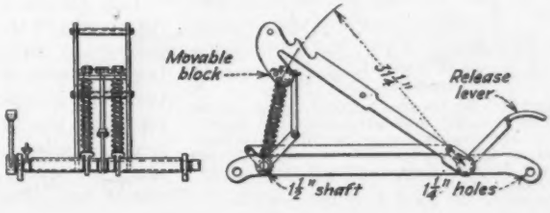


Fig. 2—Automatic lock for supply car

MINE CARS

Design, performance, and maintenance expense contrasted

A. H. Hubbell
Associate Editor

DESPITE the general excellence of the Granby-type mine car[1] for main haulage purposes, where suited to operating conditions, two other types of side-dumping cars have undeniably had wider vogue. These are the rocker-dump car and the gable-bottom car, the latter being known also as the V-bottom or saddle-back type. Both types are too well known to require description, other than that afforded by the accompanying drawings. Together with the Granby car, they constitute the group of cars from which the metal-mine operator must make, or rather is likely to make, his selection, if he wants a side-dumping car for main haulage work. Reference to the survey of prevailing mine-car practice published in *E.&M.J.* Sept. 7, 1929, pp. 400-402, will show that the three side-dumping cars named compete strongly with the rigid-box car (requiring a rotary dumper) for such work. The reader may also recall that in 1928, the American Engineering Standards Committee (now the American Standards Association) approved the use of a "roller-bearing side-dump car, not less than 3 tons' capacity," for motor haulage, as the "American recommended practice for underground transportation in metal mines." This reflected the opinion of leading metal mining engineers.

Inasmuch as knowledge of actual practice in specific instances is always helpful to anyone who has to choose between two or more kinds of equipment for particular tasks, some drawings of the rocker-dump and gable-bottom cars are presented in this article, together with pertinent data as to the conditions surrounding their use.

Just when and where the use of these cars began in the United States is rather difficult to say. One company that has been engaged in building cars for over two generations has expressed the opinion that the origin of the two types under consideration is "lost in antiquity." Another builder of long experience says that, in the Lake Superior iron country, the gable-bottom car was first used about 1893 and the rocker-dump type in 1905, whereas the rigid-box rotary dump car did not come into use there until 1915. All of these cars are undoubtedly antedated by the end-dump type. Whatever be the origin of the types mentioned, their use is widespread today, without regard to state or district boundaries.

Gable-bottom cars used by four different mining companies are shown In Figs. 5, 6, 7, and 8, respectively. In each case, the data given are furnished through the courtesy of the company named. Fig. 5 shows the 4¾-ton all-steel car used by Inspiration Consolidated Copper, at Inspiration, Ariz. Dimensions of the car and track gage may be noted in the drawing. The dimensions of the haulageway are such that the drift set consists of a 7½-ft. cap and 9-ft. posts, battered 2 in. to the foot. Sixty feet is the minimum radius of curve to be dealt with.

The ore handled is a granite and schist containing disseminated copper. It is dry and runs about 40 cu.ft. to the

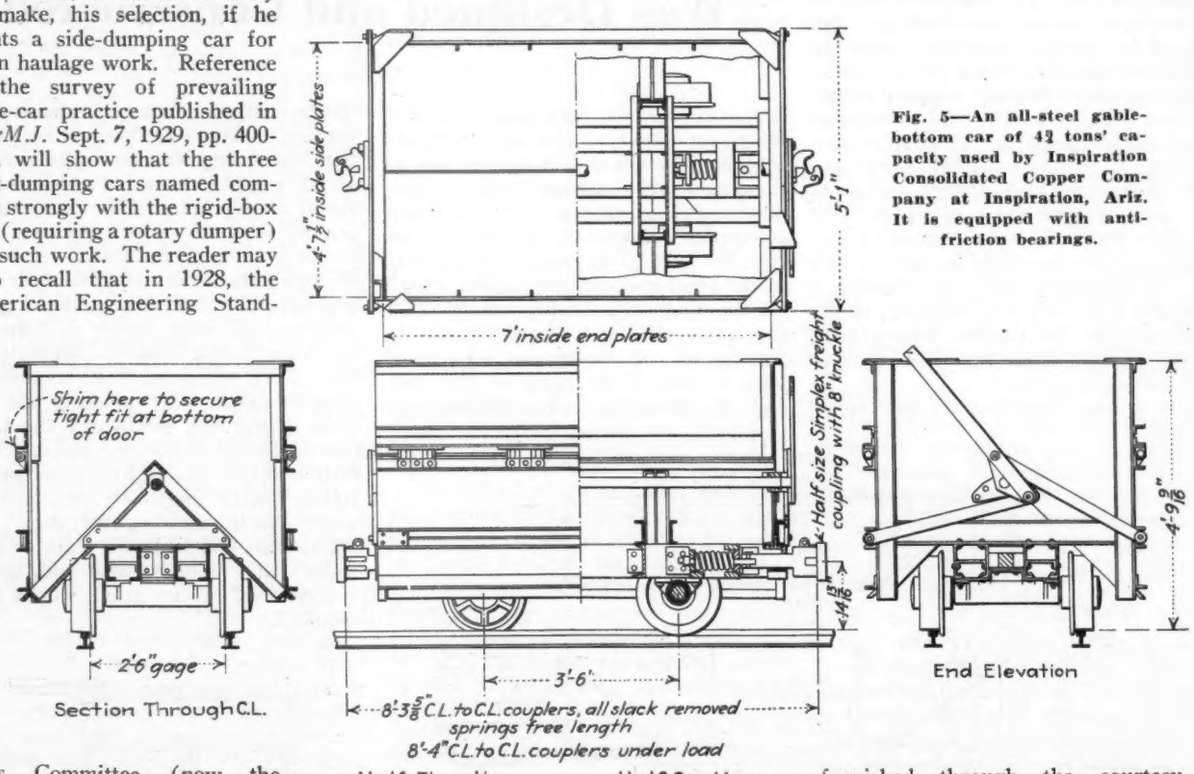


Fig. 5—An all-steel gable-bottom car of 4¾ tons' capacity used by Inspiration Consolidated Copper Company at Inspiration, Ariz. It is equipped with anti-friction bearings.

This article is the second of a series on this subject and discusses the gable-bottom and rocker-dump car of side-dumping type. The first article which appeared in *E.&M.J.* of Sept. 8, discussed the Granby-type car.

[1]Discussed in Part I of this article.

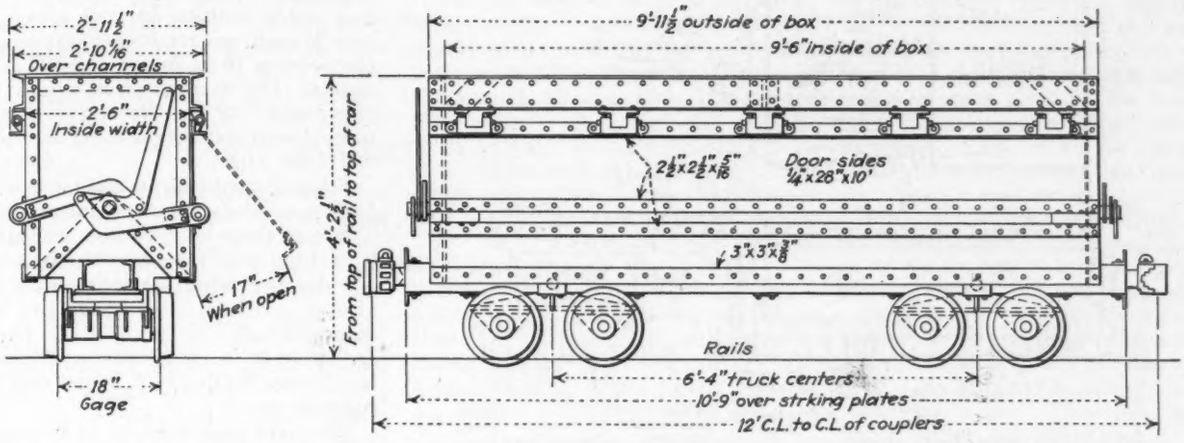


Fig. 6—A 57-cu.ft. gable-bottom car used by Park Utah Consolidated Mines Company, Park City, Utah

ton, broken. In size and weight the largest pieces are about 5 cu.ft. and 800 lb. respectively, the average weight being about 10 lb. Chute loading is employed. Loaded, the car weighs 7¼ tons; empty, 2½ tons.

Tonnage to be moved in this instance varies from 1,500 to 4,000 daily on each level. The cars are hauled in trains of ten to twenty, by 8-ton electric and 10-ton air locomotives. Average length of haul is 0.4 miles, and 30 min. is required for a round trip on the average.

Anti-friction bearings are preferred. The older cars (about 50 per cent) have plain brass bearings, but the newer ones have either Hyatt or Timken rollers.

Of very different proportions is the gable-bottom car shown in Fig. 6. This is of 57-cu.ft. capacity and is one of the three types of cars used by Park-Utah Consolidated Mines Company, Park City, Utah. A sulphide (lead-silver) ore, some of it wet and sticky, is handled in these cars. It runs approximately 17 cu.ft. per ton, broken, the largest pieces being approximately 15 in. in greatest dimension, and the average size being 3 in.

The car is loaded at chutes, its weight, full, being 7,500 lb. and, empty, 4,500 lb. It is hauled in trains of three, by a 1-ton jitney locomotive, an average distance of a quarter mile through 6½x5-ft. drifts, the minimum radius of curve being 20 ft. Here the tonnage to be moved on each level does not exceed 300 per shift.

The train is handled by one man—the motorman—without additional help either when loading or dumping. The car is new and no records as to cost of maintenence have as yet been released, although data are available regarding the 3½-ton rigid-box type car and the 1-ton end-dump car also in service at this property. These latter will be considered subsequently.

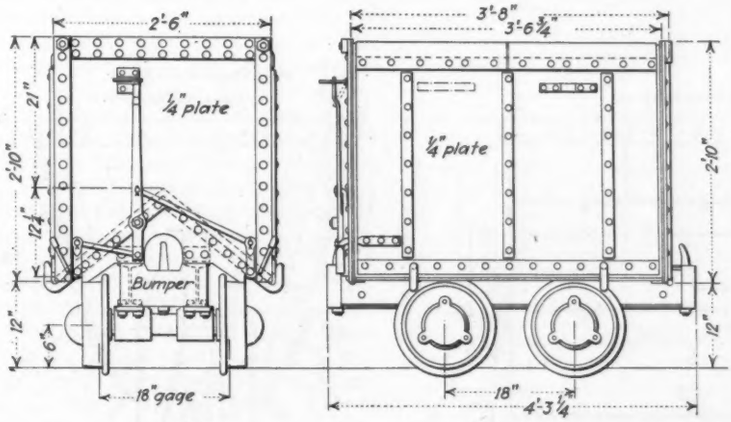


Fig. 7—This 20-cu.ft. gable-bottom car is used by the Homestake Mining Company, Lead, S. D., in some of its workings

A much smaller car of the same type is the 20-cu.ft. (1-ton) car used by Homestake Mining, at Lead, S. D., in some of its workings. This is illustrated in Fig. 7. It is used to transport a wet and sticky ore from drawholes under an open cut, the ore being a gold-bearing, altered limestone consisting of cummingtonite and chlorite, with pyrite, arsenopyrite, and pyrrhotite. Approximately 20 cu.ft. of broken ore equals 1 ton, as indicated by car capacity. The largest pieces to be handled are roughly 1-ft. cubes, weighing 200 lb. The size of the average fragment is 6x6x4 in.

Loading is done by hand shoveling and from chutes. Loaded, the car weighs 3,600 lb.; empty, 1,600. When

Track grade does not exceed 1 per cent, the average being 0.4 per cent. Three men constitute the train crew, extra men being usually required for loading but not for dumping. The number of man-hours charged monthly to car maintenance is 400. One cent per ton hauled and trammed is the cost of this maintenance.

The gable-bottom car discussed is used by Inspiration in its Live Oak Division. It is employed on intermediate levels as well as on main haulageways. In the so-called Inspiration Division, the company uses 5-ton rigid box-type cars, which are dumped by a tipple. This car will be considered in a later article.

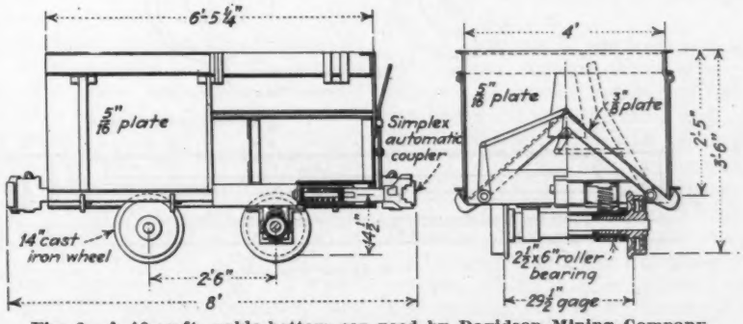


Fig. 8—A 40-cu.ft. gable-bottom car used by Davidson Mining Company, Iron River, Mich.

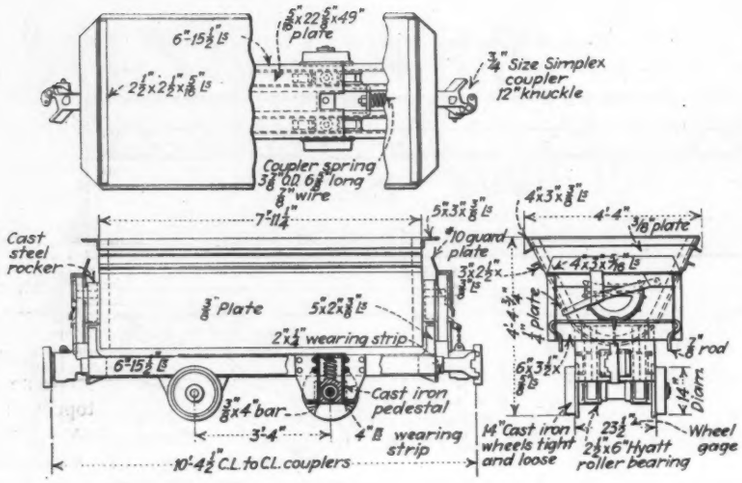


Fig. 9—Rocker dump car of 58 cu.ft. capacity used by M. A. Hanna Company at Iron River, Mich.

hand-trammed, the car is moved an average distance of 200 ft. It is also hauled in trains of twenty cars, by 5-ton high-pressure-air locomotives, the average distance being a quarter of a mile. Track grade is 0.25 per cent on an average and 1 per cent maximum. The car is equipped with anti-friction roller bearings.

The total daily mine tonnage is 3,500, including all levels and two types of cars in use, the other type being a 1-ton end-dump car (to be discussed subsequently). Under certain conditions, the management states, the end-dump is preferable to the side-dump, so both types are used. However, a car having a capacity greater than 1 ton would be better if more clearance could be obtained without material increase in cost of drifts and tunnels. Present haulageways are 7x7 ft. in cross-section, the minimum radius of curves being 30 ft.

Train crews consist of two men each, no additional men being provided for loading and dumping. Car-maintenance costs in this instance are not available.

Figure 8 shows a 40-cu.ft. car of the gable-bottom or saddle-back type used by the Davidson Ore Mining Company at Iron River, Mich., on the Menominee range. In this mine, the iron ore is neither wet nor sticky. It runs 17 cu.ft. per ton broken, the largest pieces being 16 in. in size and 300 lb. in weight. The average piece weighs approximately 25 lb. The car is loaded from chutes, and weighs 6,500 lb. loaded and 2,400 empty.

Tonnage requirements call for moving 1,000 tons daily on the haulage level. Trains of three to seven cars are hauled by a 4-ton trolley locomotive, the average distance being a quarter mile, the average grade 0.5 per cent, and the minimum radius of curve, 30 ft. Drifts are 10x10 ft. in cross-section. The cars have roller bearings. A round trip requires 8 min.

The train crew consists of two men, extra help being provided when loading and dumping. No facts regarding cost of car maintenance are at this time available.

Two cars of the rocker-dump type are shown in Figs. 9 and 10. The first of these is of 58 cu.ft. capacity and is used by the Hanna Ore Mining Company at Iron River, Mich. The iron ore breaks in angular lumps, is dry, and, when broken, runs 15 cu.ft. to the ton. In size and weight, the lumps average 10x6x8 in. and 50 lb. respectively. The largest pieces weigh approximately 250 lb. and approach 12x18x24 in. in dimensions. All cars are loaded from chutes, the weight loaded being approximately 12,600 lb. and that of the empty car, 4,600 lb.

The ore is hauled in trains of four to

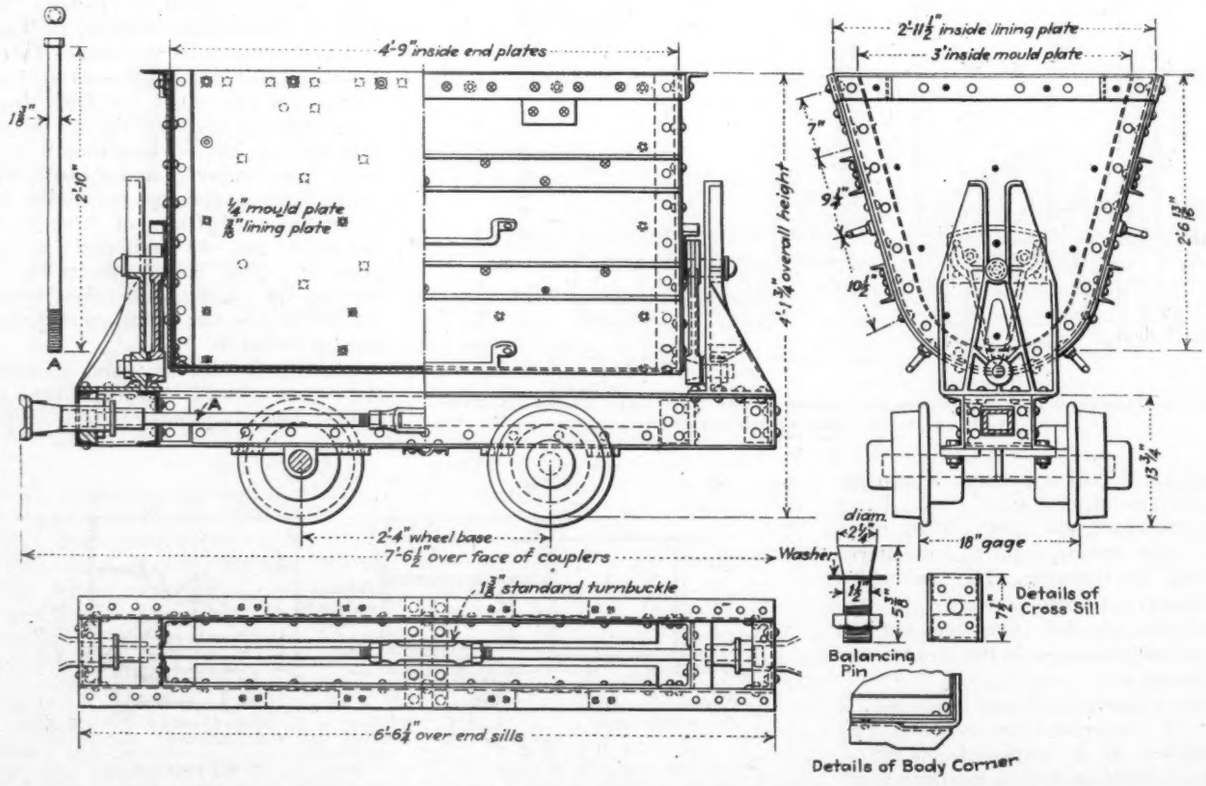


Fig. 10—Rocker-dump car of 30 cu.ft. capacity used by United Verde Copper Company, Jerome, Ariz.

five cars by 4-ton trolley locomotives, the average haul being 1,000 ft., average grade 0.43 per cent, and the minimum radius of curve 20 ft. The cars are equipped with anti-friction bearings. Drifts are 9x9 ft. in cross-section. Average time required for a round trip is 20 min.

Two men constitute a train crew, one extra man being required for loading but none for dumping. Approximately two man-hours per month are charged to car maintenance—a negligible amount.

A so-called "trunnion dump" car (also a rocker-dump type) used by United Verde Copper Company, Jerome, Ariz., is shown in Fig. 10. It is of 30 cu.ft. capacity and weighs 5,000 to 6,000 lb. loaded and 2,475 lb. empty. It has anti-friction bearings.

The ore handled varies in character, being massive sulphide, schist or porphyry, as the case may be, and is dry and does not become sticky. Broken, it averages 18 cu.ft. per ton. The average piece weighs 10 lb. and will pass an 11-in. grizzly. Pieces weighing 200 lb. and approximating 11x24x6 in. in dimensions must be handled. Loading is done partly by hand-shoveling, partly from chutes, and occasionally by mechanical means.

Maximum tonnage requirements on each level are 500 tons per eight-hour shift. Ore transport is effected by hand-tramming and by train haulage, the average distance in the former case being 150 ft. and, in the latter, 1,200 ft. A 5-ton storage-battery locomotive is used in the latter case, drawing a train of fifteen cars. Drifts are 6x8 ft. and 5x7 ft. in cross-section; the average track grade is 0.4 per cent, the maximum 0.75 per cent; and the minimum radius of curve is 40 ft. On the average, a round trip takes 22 min., the crew consisting of two men. No extra men are required for loading, but on dumping a grizzly man assists.

One thousand man-hours are charged per month to car maintenance, the cost of such maintenance being estimated as $0.01 per ton hauled and trammed.

Besides this trunnion-dump car, the United Verde company also uses an 18-cu.ft. scoop-body car for waste tramming, in cut-and-fill stopes and in square-set stopes. This will be discussed further in a future issue.

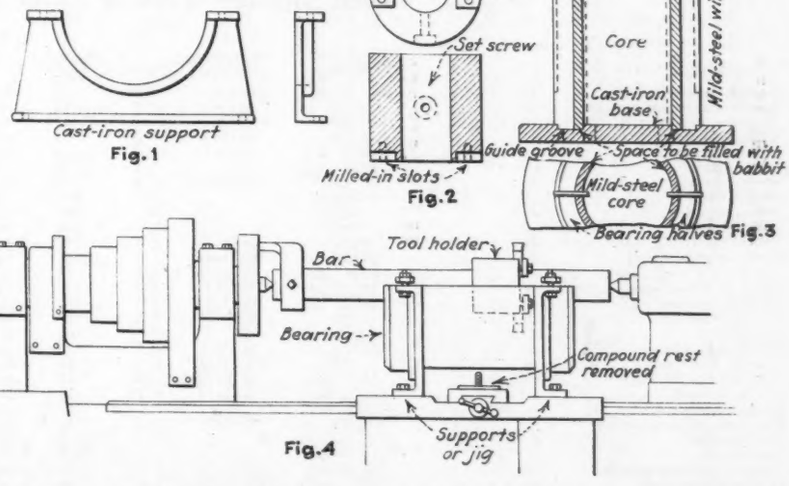
(To be continued)

Repairs at Diesel Plant Cut Power Costs

LOWER-generating costs are influenced materially by the oft-considered-unimportant item of "repairs." Low repair costs usually mean low power costs, but such costs can be obtained only by employing time- and material-saving shop methods and a well-organized repair system at the power house. This has been successfully accomplished by R. M. McDougall, superintendent of power at the Diesel power plant of the Phelps Dodge Corporation, at Morenci, Ariz. A description follows of shop methods developed recently for the babbitting and turning of crankshaft and wrist bearings, which methods play an important part in the maintenance of a Diesel engine:

As shown in Fig 3 of the accompanying illustration, the babbitting of bearings is performed with a specially designed device consisting of a cast-iron base, a self-adjusting clamp, and a machined mild-steel core equipped with two welded-on wings, the thickness of which corresponds to the space required to accommodate the sheet-iron or brass supplements for adjusting the bearings. To facilitate an immediate centering of the bearing halves, to eliminate the pouring of considerable excess material, and to prevent a leakage of molten babbitt, the base is provided with a shallow groove, into which one bearing end is placed. An excess of but $\frac{1}{16}$ in. of material is sufficient to insure a clean finish of the bearing. The savings thus effected are obvious. With the clamp placed tightly around the upper section of the bearing to insure additional safety, the apparatus is now ready to receive the molten babbitt. After being cooled, each bearing is turned in the lathe to the proper diameter, as shown in Fig. 4. This is a novel feature compared with the former face-plate method, which necessitated considerable time to secure and center the bearing to the face plate, and which frequently resulted in an uneven bore that required additional scraping because of the necessarily long tool bar being subject to vibration. With the conversion of the lathe into a boring mill, these difficulties have been overcome completely. The bearing now rests in two machined cast-iron supports (see Fig. 1), which are carefully spaced, centered, and secured to the lathe saddle after the compound rest has previously been removed. An extra heavy bar, containing the adjusted roughing tool, is placed between the live and dead center of the lathe, and the first cut made. As shown in Fig. 2, a second bar, equipped with a specially large tool holder to eliminate all vibration, is provided for the finishing cut.

Details of babbitting and turning a crankshaft



The adjusting of the tools is a simple matter and requires little time; once adjusted, a definite number of bearings can be turned with the same tool. With the method described, four bearings are turned and finished per eight-hour shift, as compared to one bearing with the old method. The wrist bearings are babbitted and turned in almost an identical manner, with the exception of the support, which is of a different design that permits four to six bearings to be bored at a time.

Food Requirements

An Important Consideration in Mining Operations

No branch of management is more worthy of study than that which is concerned with the proper feeding of mine employees, the satisfaction of whom, in this respect, is an ideal deserving of adequate planning. At the same time, no phase of operations offers greater opportunity for waste and unnecessary expense. As in other branches of the work, the first requirement is to know the facts; the second, to maintain as rigid a system of control and economy as is consistent with requirements and productive of maximum contentment. The cost of food eaten or wasted on a mining property is as important as the cost of the other necessary supplies. The demands of adequacy and efficiency can only be met if experience is gained and recorded, and some standard is adopted as a basis for practice and comparison. The data presented herewith, courteously and thoughtfully released for publication by Mr. Daniel J. Williams, manager of the Hirst-Chicagof Mining Company, operating at Juneau, Alaska, will prove helpful, as well as stimulative of increased attention to a subject that affects employer-employee relations as well as the economic success of an enterprise. Dr. L. V. Burton, of the editorial staff of "Food Industries," to whom the tables were submitted for expert opinion, states that the ménu is adequate in quantity and in every important dietetic essential.

Food Supplies—Crew of 25 for 30 Days

Article		1 Size of Package	2 Dimensions (Inches)	3 Cu.Ft.	4 Weight, (Lb.)	5 Av. Price, Seattle	6 Quantity Cs. or Lb.	7 Quantity Unit Pkgs.	8 Per Man per Day
Apples, evaporated	bx.	25 lb.	10x11x17	1/1	31	lb., $0.17½	10.4 lb.	10.4 lb.	
Apples, can, solid pack	cs.	6/10s	8x13x21	1/3	52	cs., 2.25	1.54 cs.	9.25 t	
Apricots, evaporated	bx.	25-lb.	7x10x16	–/9	28¾	lb., 0.27½	8.33 lb.	8.33 lb.	
Apricots, canned	cs.	6/10s	8x13x21	1/3	52	cs., 3.75	1.58 cs.	9.5 t	
Baking powder	cs.	6/5- lb.	9x12x18	1/2	35	cs., 6.38	2.5 lb.	2.5 lb.	
Baking soda	cs.	60/1- lb.	.....	1/6	70	cs., 4.35	2.5 lb.	2.5 lb.	
Barley, pearl	bx.	25-lb.	9x10x14	–/9	30½	lb., 0.06½	4.33 lb.	4.33 lb.	
Beans, bayo	sk.	100-lb.	.....	2/–	100	cwt., 10.50	20.83 lb.	20.83 lb.	0.03 lb.
Beans, small white	sk.	100-lb.	.....	2/–	100	cwt., 11.00	12.5 lb.	12.5 lb.	0.02 lb.
Beans, lima	sk.	100-lb.	.....	2/–	100	cwt., 16.75	12.5 lb.	12.5 lb.	0.02 lb.
Beans, cut string, can	cs.	6/10s	8x13x21	1/3	47	cs., 3.25	0.87 cs.	5.25 t	
Beets, whole canned	cs.	24/2½ s	10x13x18	1/4	61	cs., 5.50	0.75 cs.	18.0 t	
Butter, dry pack (prints)	cs.	60/1- lb.	8x16x20	1/6	71	lb., 0.50	105.0 lb.	105.0 lb.	0.14 lb.
Bran, all ¾ Kelloggs	cs.	24/10-oz.	10x14x15	1/3	18	cs., 2.50	0.12 cs.	3.0 pkg.	
Brussels sprouts, can	cs.	24/2s	10x11x14	–/11	42	cs., 5.30	0.46 cs.	11.0 t	
Catsup, canned	cs.	6/10s	8x13x21	1/3	50	cs., 3.50	0.12 cs.	0.75 t	
Cayenne	t.	5-lb.	.....	...	5	lb., 0.49	0.25 lb.	0.25 lb.	
Celery salt (glass)	cs.	12/2- oz.	6x 7x 9	–/3	6	cs., 1.35	0.25 cs.	3.0 bot.	
Cheese, American	cs.,	60-lb.	15x15x16	2/4	68	lb., 0.28	20.0 lb.	20.0 lb.	0.03 lb.
Chocolate (½ lb. cakes)	cs.	24/8- oz.	7x 7x10	–/3	14	cs., 2.40	0.08 cs.	0.50 lb.	
Cocoa, ground	cs.	12/1- lb.	6x12x13	–/7	14	cs., 2.40	.....	.....	
Cocoanut, shredded	cs.	15/1- lb.	.....	....	17	cs., 6.90	0.63 lb.	0.63 lb.	
Cherries, red sour pitted	cs.	6/10s	8x13x21	1/3	53	cs., 6.13	1.04 cs.	6.25 t	
Chili powder	t.	1- lb.	.....	....	1	lb., 0.70	0.04 lb.	0.04 lb.	
Cinnamon	t.	1- lb.	.....	....	1	lb., 0.30	0.08 lb.	0.08 lb.	
Citrus (washing) powder	cs.	24/28-oz.	11x16x19	1/11	56	cs., 5.00	0.33 cs.	8.0 pkg.	
Clams, whole razor	cs.	48/ tall	10x13x20	1/6	68	cs., 14.40	0.46 cs.	22.0 t	
Cloves, whole	bk	.....	.....	....	.....	lb., 0.40	.....	.....	
Cloves, ground	t.	1- lb.	.....	....	1	lb., 0.65	.....	.....	
Bay leaves	bk.	.....	.....	....	.....	lb., 0.16	0.08 lb.	0.08 lb.	
Codfish, A-1 boneless	cs.	12/1- lb.	.....	.....	.....	lb., 0.27	.....	.....	
Coffee	cs.	20/5- lb.	18x22x28	6/5	155	lb., 0.44	70.08 lb.	70.08 lb.	0.09 lb.
Corn, sweet canned	cs.	24/2s	10x11x14	–/11	32	cs., 3.20	1.75 cs.	42.0 t	
Corn on cob	cs.	24/2½s	10x13x18	1/4	52	cs., 6.50	0.54 cs.	12.0 t	
Corn flakes	cs.	36/8- oz.	18x20x20	4/2	28	cs., 2.85	0.33 cs.	12.0 pkg.	
Corn meal	sk.	49-lb.	.....	1/–	49	sk., 1.75	2.0 lb.	2.0 lb.	
Cornstarch	cs.	48/1- lb.	10x14x18	1/6	50	lb., 0.07	4.33 lb.	4.33 lb.	
Cream tartar	t.	1- lb.	.....	....	1	lb., 0.40	.....	.....	
Crackers, soda	bx.	16–18-lb.	12x13x22	2/–	27–29	lb., 0.11	8.5 lb.	8.5 lb.	0.01 lb
Cracker meal	bx.	25-lb.	6x13x22	1–	29	lb., 0.10	2.0 lb.	2.0 lb.	
Currants, pkgs	bx.	36/1- lb.	12x12x14	1/2	45	lb., 0.19½	4.5 lb.	4.5 lb.	
Curry powder	t.	1- lb.	.....	....	1	lb., 0.40	.....	.....	
Dutch cleanser	cs.	48/14-oz.	11x14x20	1/9	54	cs., 3.15	0.08 cs.	4.0 pkg.	
Egg color (glass)	bot.	32-oz.	.....	....	32 oz.	bot., 1.25	2.67 oz.	2.67 oz.	
Farina (cream of wheat)	sk.	49-lb.	.....	1/–	49	sk., 1.90	4.08 lb.	4.08 lb.	
Flour, white (bread)	bbl.	2/49–4/49-lb.	.....	....	.....	bbl., 8.00	2.38 bbl.	475.0 lb.	0.63 lb.
Flour, graham (coarse)	bbl.	2/49–4/49-lb.	.....	....	.....	bbl. 7.20	0.08 bbl.	16.67 lb.	0.02 lb.
Figs, evap. white or black	bx.	25-lb.	7x10x16	–/8	28	lb., 0.12½	4.17 lb.	4.17 lb.	
Gelatine	pkg.	1- lb.	.....	....	1	0.85	0.25 lb.	0.25 lb.	
Ginger	t.	1- lb.	.....	....	1	lb., 0.60	.....	.....	
Grapefruit, can. (Florida)	cs.	24/2s	10x11x15	–/11	44	cs., 5.00	1.13 cs.	27.0 t	
Horseradish (dry) (glass)	cs.	12/2- oz.	6x 7x 9	–/3	6	cs., 2.10	0.13 cs.	1.5 bot.	
Hominy, can	cs.	24/2½s	10x13x18	1/4	52	cs., 2.70	0.13 cs.	2.0 t	
Jam, canned	cs.	6/10s	8x13x21	1/3	55	cs., 6.50	0.08 cs.	0.5 t	
Jello (institutional size)	cs.	12/ inst.	7x12x16	–/9	25	cs., 6.80	0.38 cs.	4.5 kg.	
Jelly, canned	cs.	6/10s	8x13x21	1/3	55	cs., 6.25	0.13 cs.	0.75 t	

Article		1 Size of Package	2 Dimensions (Inches)	3 Cu.Ft.	4 Weight, (Lb.)	5 Av. Price, Seattle	6 Quantity Cs. or Lb.	7 Quantity Unit Pkgs.	8 Per Man per Day
Lemon extract (glass)	bot.	32-oz.	.....	.....	32 oz.	bot., 4.00	12.0 oz.	12.0 oz.	
Loganberries, canned	cs.	6/10s	8x13x21	1/3	53	cs., 3.70	0.17 cs.	1.0 t	
Lye (can.)	cs.	48/13-oz.	8x13x18	1/1	50	cs., 4.80	0.08 cs.	4.0 t	
Mace	t.	1- lb.	.....	.....	1	lb., 1.60	.....	.....	
Macaroni, long	bx.	25-lb.	9x10x23	1/2	31½	cs., 2.10	4.17 lb.	4.17 lb.	
Macaroni, elbow	bx.	25-lb.	9x11x15	–/10	26½	bx., 2.10	4.17 lb.	4.17 lb.	
Mazola oil (salad oil)	cs.	2/5- gal.	11x16x21	2/2	94	gal., 1.30	0.42 gal.	0.42 gal.	
Matches	cs.	24/6- bx.	12x16x25	2/11	42	cs., 4.75	.....	.....	
Milk, canned	cs.	48-tall	9x13x18	1/3	60	cs., 4.40	8.33 cs.	400.0 t.	0.53 t
Mincemeat, Libby's moist	kit.	25-lb.	13x13x10	1/–	35	lb., 0.19	.....	.....	
Molasses, New Orleans	cs.	12/5- lb.	11x12x17	1/4	65	cs., 5.65	0.04 cs.	1.0 t.	
Mapleine, Crescent (glass)	bot.	32-oz.	.....	.....	32 oz.	bot., 2.75	2.66 oz.	2.66 oz.	
Mustard, dry, Colman	t.	1-lb.	.....	.....	1	lb., 0.95	0.04 lb.	0.04 lb.	
Mushrooms, (dry)	t.	5-lb.	.....	.....	5	t., 1.35	.....	.....	
Noodles, broad	bx.	25-lb.	7x10x23	–/11	27½	bx., 2.35	1.0 lb.	1.0 lb.	
Nutmeg, ground	t.	1-lb.	.....	.....	1	lb., 0.75	0.04 lb.	0.04 lb.	
Onion salt (glass)	cs.	12/2- oz.	6x 7x 9	–/3	6	cs., 1.35	0.08 cs.	1.0 bot.	
Oysters, canned	cs.	24/2s	9x11x15	–/10	33	cs., 6.20	0.75 cs.	18.0 t.	
Peaches, canned	cs.	6/10s	8x13x21	1/3	51	cs., 3.75	1.92 cs.	11.5 t.	
Peaches, evaporated	bx.	25-lb.	10x11x17	1/1	28½	lb., 0.21	.....	.....	
Pears, canned	cs.	6/10s	8x13x21	1/3	52	cs., 4.25	2.29 cs.	13.75 t.	
Peas, canned	cs.	6/10s	8x13x21	1/3	49	cs., 3.75	0.92 cs.	5.5 t.	
Peas, yellow split	bx.	25-lb.	9x10x14	–/9	30½	lb., 0.08½	11.46 lb.	11.46 lb.	
Paprica	t.	1-lb.	.....	.....	1	lb., 0.67	.....	.....	
Pepper, black	t.	5-lb.	.....	.....	5	lb., 0.54	1.04 lb.	1.04 lb.	
Pickles, sweet or sour mix	cs.	61-gal.	10x13x21	1/7	72	cs., 7.00	1.0 qt.	1.0 qt.	
Pineapple, sliced	cs.	6/10s	8x13x21	1/3	52	cs., 4.93	1.25 cs.	7.5 t.	
Plums or prunes, canned	cs.	6/10s	8x13x21	1/3	53	cs., 2.13	0.17 cs.	1.0 t.	
Prunes, evaporated	bx.	25-lb.	7x10x15	–/7	28	lb., 0.11½	33.33 lb.	33.33 lb.	0.05 lb
Pumpkin, canned	cs.	24/2½s	10x13x18	1/4	62	cs., 3.30	0.04 cs.	1.0 t.	
Raisins, seedless	bx.	25-lb.	7x11x17	–/9	30½	lb., 0.07½	10.42 lb.	10.42 lb.	
Red peppers, long	bk.	.....	.....	.....	.....	lb., 0.35	0.21 lb.	0.21 lb.	
Rhubarb, canned	cs.	6/10s	8x13x21	1/3	53	cs., 2.13	0.17 cs.	1.0 t.	
Rice, fancy head	sk.	100-lb.	.....	2/–	100	cwt., 9.00	12.5 lb.	12.5 lb.	0.02 lb.
Rolled oats	sk.	90-lb.	.....	4/–	90	sk., 4.00	18.75 lb.	18.75 lb.	0.03 lb.
Ry. Krisp	cs.	18/1- lb.	10x12x26	1/10	24	cs., 4.10	0.29 cs.	5.25 pkg.	
Red color (glass)	bot.	32-oz.	.....	.....	32 oz.	bot., 1.25	1.33 oz.	1.33 oz.	
Sage	t.	1-lb.	.....	.....	1	..... 0.40	.....	.....	
Salt, shaker	cs.	24/2- lb.	12x12x16	1/4	51	cs., 2.00	.....	.....	
Salt, table (bale 150 lb.)	bale.	75/2- lb.	.....	3/–	150	bale 4.00	43.75 lb.	43.75 lb.	0.06 lb.
Salt, rock (half ground)	bag.	50-lb.	.....	1/–	50	bag, 0.48	4.17 lb.	4.17 lb.	
Saltpeter	bk.	.....	.....	.....	.....	lb., 0.35	0.42 lb.	0.42 lb.	
Sardines, Norwegian	cs.	100/16s	.....	.....	.....	cs., 6.00	0.29 cs.	29.0 t.	
Sauerkraut, canned	cs.	24/2½	8x10x13	1/4	55	cs., 3.70	0.63 cs.	15.0 t.	
Shortening compound	drum.	45-lb.	13x14x15	1/7	52	lb., 0.14	60.0 lb.	60.0 lb.	0.08 lb.
Soap, white laundry	cs.	100-bars	10x14x15	1/3	56	cs., 4.00	0.71 cs.	71.0 bars	0.02 bars
Spinach, canned	cs.	24/2½	10x13x18	1/4	55	cs., 3.50	0.67 cs.	16.0 t.	
Spaghetti	bx.	25-lb.	6x10x23	–/10	30	bx., 2.35	6.25 lb.	6.25 lb.	
Sugar, white cane	sk.	100-lb.	.....	2/–	100	cwt., 5.60	400.0 lb.	400.0 lb.	0.53 lb.
Sugar, brown	sk.	100-lb.	.....	2/–	100	cwt., 5.10	12.5 lb.	12.5 lb.	
Sugar, powdered	bx.	30-lb.	10x10x16	–/11	35	lb., 0.07	3.75 lb.	3.75 lb.	
Sweet potatoes, canned	cs.	24/2½s	10x13x18	1/4	54	cs., 3.70	0.17 cs.	0.4 t.	
Tapioca, med. or small	bx.	25-lb.	9x10x15	–/9	31	lb., 0.06½	6.0 lb.	6.0 lb.	
Tea, English bkfst	bx.	25-lb.	10x14x18	1/4	35	lb., 0.35	2.0 lb.	2.0 lb.	
Thyme	t.	1-lb.	.....	.....	1	lb., 0.35	.....	.....	
Toothpicks	Hotel size.	.....	.....	.....	.....	doz., 1.00	1.0 pkg.	1.0 pkg.	
Tomatoes, canned solid pack	cs.	24/2½s	10x13x18	1/4	53	cs., 3.50	.....	.....	
Tomatoes, can. solid pack	cs.	6/10s	8x13x21	1/3	52	cs., 3.25	2.38 cs.	13.25 t.	
Vanilla extract (glass)	bot.	32-oz.	.....	.....	32 oz.	bot., 4.00	6.67 oz.	6.67 oz.	
Vermicelli	bx.	25-lb.	6x10x23	–/10	29½	bx.., 2.10	2.0 lb.	2.0 lb.	
Vinegar (glass)	cs.	12/32-oz.	12x13x17	1/6	50	cs., 2.50	0.38 cs.	4.5 bot.	
Walnuts, shelled Manchurian	bk.	.....	.....	.....	.....	lb., 0.46	.....	.....	
Worcestershire sauce (gl.)	cs.	12/5- oz.	8x10x 9	–/5	13	cs., 3.15	0.13 cs.	1.5 bot.	
Yeast, magic (dry)	cs.	18/2- oz.	4x 5x 9	–/1	3½	cs., 1.40	.....	.....	
Yeast, Fleischmann	brick.	1- lb.	.....	.....	1	lb., 0.65	4.0 lb.	4.0 lb. (a)	
Vegetables									
Cabbage	cr.	100-lb.	14x19x24	3/8	110	lb., 0.03	104.0 lb.	104.0 lb.	0.14 lb.
Carrots	sk.	100-lb.	.....	2/–	100	lb., 0.02	79.0 lb.	79.0 lb.	0.11 lb.
Garlic	bk.	.....	.....	.....	.....	lb., 0.16	0.92 lb.	0.92 lb.	
Onions	sk.	100-lb.	.....	2/–	100	lb., 0.02¾	100.0 lb.	100.0 lb.	0.13 lb.
Parsnips	sk.	90-lb.	.....	2/–	90	lb., 0.03	30.0 lb.	30.0 lb.	0.04 lb.
Potatoes	sk.	100-lb.	.....	2/–	100	lb., 0.03	558.33 lb.	558.33 lb.	0.75 lb.
Rutabagos	sk.	100-lb.	.....	2/–	100	lb., 0.02	33.33 lb.	33.33 lb.	0.04 lb.
Turnips	sk.	100-lb.	.....	2/–	100	lb., 0.02½	16.67 lb.	16.67 lb.	0.02 lb.
Meat									
Beef, quarter	Average weight.	160-lb.	.....	.....	.....	lb., 0.24	632.08 lb.	632.08 lb.	0.84 lb. (a)
Pork, side trim	Average weight.	33-lb.	.....	.....	.....	lb., 0.33	159.58 lb.	159.58 lb.	0.21 lb. (a)
Bacon, breakfast	Average cs. net.	158-lb.	12x18x30	3/9	.....	lb., 0.27	85.13 lb.	85.13 lb.	0.11 lb.
Ham, medium	Average cs. net.	145-lb.	12x18x30	3/9	.....	lb., 0.27½	134.79 lb.	134.79 lb.	0.18 lb.
Sausage, salt link	Keg net	35-lb.	12x12x18	1/6	50	keg, 9.25	.....	.....	
Sausage, link pork	bk.	.....	.....	.....	.....	lb., 0.30	.....	.....	(a)
Sausage, bologna	bk.	.....	.....	.....	.....	lb., 0.30	.....	.....	(a)
Pigs feet, pickled	keg, net	35-lb.	12x12x18	1/6	50	keg, 5.00	.....	.....	
Frankfurters	bk.	.....	.....	.....	.....	lb., 0.30	.....	.....	(a)
Eggs, standard fresh ranch	cs.	30-doz.	12x13x26	2/4	62	doz., 0.40	4.33 cs.	130.0 doz.	(a)

(a) Bought in Juneau.

THE accompanying table gives the food supply required for a crew of 25 men for 30 days. Column 1 gives the units in which all articles are purchased, and the net weight of the content of the containers in pounds and ounces, the number and sizes of tins and glasses of preserved foods, and the liquid content of bottles. The gross weight, also in pounds and ounces, is given in Column 4. In Column 2 may be found the dimensions of the containers in inches, and in Column 3 the cubical content in cubic feet and twelfths of a cubic foot. In order to get a basis for calculating freight rates, 1 cu.ft. is considered to weigh 50 lb., giving 40 cu.ft. to the ton. In this case the shipping company reserves the option to calculate the freight on the basis of weight or cubical content. Prices given in Column 5 are average prices at Seattle, unless otherwise stated. Columns 6 and 7 give the total number of the different units required for the crew during the 30-day period, and Column 8, the quantities of staple items consumed by one man per day. A gross weight of 7 lb. per man should be allowed daily.

The following abbreviations have been used: bbl. = barrel; bx. = box; cwt. = 100 lb.; bot. = bottle; cs. = case; pkg. = package; t. = tin; sk. = sack; oz. = ounce; lb. = pound.

SIXTY YEARS AGO

1870-1930

MAN OF THE SO-CALLED CIVILIZED TYPE is gregarious intellectually as well as socially. This fact, demonstrated early in our own industrial era, had long been recognized in England and on the Continent. The American Society of Mechanical Engineers celebrated, on April 5, 1930, the fiftieth anniversary of its organization, in part and fittingly enough in the McGraw-Hill Building and under the auspices of one of the deans of our publishing organization, *American Machinist*. In 1880, the editors of that magazine, sensing the need of a fraternal and technical organization possessing the bond of identical professional interest and aspiration, held a memorable meeting in the staff offices, at which gathering the A.S.M.E. found its inception.

Even older is the Institute — the A.I.M.E. An editorial in *Engineering and Mining Journal* of Feb. 7, 1871, contained the first announcement to the profession and industry of mining engineering of a proposal that had long been favored by its editor, Dr. Rossiter W. Raymond—the forming of a professional society to be known as the American Institute of Mining Engineers, in the fostering and direction of which he subsequently played so zealous and honorable a rôle. Doctor Raymond, as befitted one with the best interests of the industry at heart, was tireless in urging the free interchange of experiences, among those engaged in technical work. "It is therefore proposed," he announced, "to establish an American Institute of Mining Engineers which will hold its meeting periodically in the great mining and metallurgical centers." The printing and distribution of the papers presented and the discussion contributed at such meetings would be an obligation of the new Institute. These "transactions" or "proceedings," Doctor Raymond averred, "would form, when published, a valuable and greatly needed addition to our technical literature."

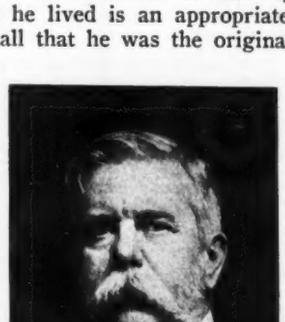
The initial circular calling a meeting to organize the new society was signed by three engineers, one of whom was R. P. Rothwell, who later became joint editor with Doctor Raymond of *E.&M.J.* Thus the early history of the Institute was directly linked with that of the industry's mouthpiece. Of the four who organized the Institute—E. B. Coxe, R. P. Rothwell, M. Coryell, and R. W. Raymond—two directed the editorial performance and policies of this publication. *Engineering and Mining Journal* gave the necessary impetus to the scheme and provided space for accounts of meetings and progress. Doctor Raymond, its editor, was virtually the president of the Institute from the time of its foundation, although David Thomas filled that post by name if not by performance for a few months before Doctor Raymond became titular head, to hold the office until he himself introduced an amendment to the constitution that limited presidential service to two years only. In 1884 he became secretary of the Institute, the duties of which he performed with keen perception, rare charm, and conspicuous literary ability. His retirement in 1912 was followed by close association with the Institute, as Secretary Emeritus, until his death in 1918. And during this period he was a valued contributor to *Engineering and Mining Journal*.

In its issue of May 30, 1871, *E.&M.J.* presented a complete report of the first meeting of the Institute, which was held at Wilkes-Barre, Pa., on May 16, 17, and 18. The list of officers and associated members constitutes a memorable and honorable roster. To the loyalty, intelligence, and zeal of these pioneers the mining industries owe a deep and lasting obligation of honor and respect — as do also *E.&M.J.* and the Institute.

THE LIFE AND ATTAINMENTS of George Westinghouse, inventor, industrialist, and humanitarian, who lived from 1846 to 1914, have been immortalized in a beautiful memorial recently unveiled in Schenley Park, Pittsburgh. Westinghouse is not especially identified, in popular conception, with the mining industries, but after a successful career as an inventor and in business he purchased, in the late 'nineties, a tract of land in Vermont which was supposed to contain valuable deposits of copper. The place was hopefully named "Copperfield." No exploitation was attempted until 1903, when Westinghouse sent a corps of men, under the command of a young mining engineer, into Vermont to start operations. As a preliminary to development a clubhouse was erected and elaborately furnished. Funds were supplied by Westinghouse's Pittsburgh representative, the inventor himself being in Europe at the time. After the structure's completion a telegraphic requisition was received in Pittsburgh for a large sum to be expended for "Oriental rugs." The amount asked appeared to Westinghouse's representative to be excessive, and the young folks in "Copperfield" were put off with the suggestion that they await "the Chief's" return from abroad.

When he reached New York, Westinghouse sent for the young boss miner in Vermont. On his asking his manager how matters were progressing at "Copperfield," the boy from the field said: "Oh, everything is going along fine. Although we have not been able to do much actual work yet, I have built a handsome clubhouse for our men. It is all but completed. What we still need are some Oriental coverings for the floors." Westinghouse had been fully informed on the matter. Giving his embryo miner one of the quick once-overs for which he was famous, he thus advised him: "Young man, that property cost me $200,000, and you have not done anything else up there except spend money. Until you get busy and show me some returns on my investment you will have to do without the Oriental rugs and 'stand on a feather.'"

The present celebration of Westinghouse's contributions to the age in which he lived is an appropriate time to recall that he was the originator of



GEORGE WESTINGHOUSE
1846-1914

the Saturday half-holiday idea, back in 1871. The shorter week was then initiated for his Brake Company force. Some years previously he had remarked to his father: "If I ever become an employer—and I shall, some day—those who work for me shall have Saturday afternoons for themselves, whether it be for play, for recreation, or for any other enjoyment." Whatever virtue there may be in the current proposals for, and discussions of, the shorter year, month, week, and day, they scarcely bear the stamp of novelty. In fact, Moses, in the second chapter of Genesis, records that the Creator, having finished his job, "rested on the seventh day from all his work." And that was some time before Westinghouse conceived of his improvement, as here recorded: going the Lord a half a day better.

Square-Set Stoping

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NEW and improved systems of mining have in recent years reduced the relative tonnage of ore produced by the square-set system of stoping. Although in many mines square-setting is still the most important method, in others it is gradually being replaced in part by different methods. Nevertheless, this old and reliable method will always hold a prominent place in stoping, if for no other reason than as an auxiliary to the methods now more generally used.

In many operations square-setting is used to mine the pillars left by these other methods, and it is generally used in taking out pillars under old stopes. For example, if a cut-and-fill stope is being worked under a section that has been mined out, the last 20 to 40 ft. of the orebody is stoped with square-sets. In this case the cut-and-fill stope is leveled off and changed over to a square-set stope. Whenever there is a change of ground in an open stope, making it dangerous to mine, square-setting is resorted to for the extraction of the remaining ore. In some of the cut-and-fill methods a section is bounded on two sides by lines of square-sets. Where such a stope is 50 ft. wide, approximately 20 per cent of the ore is coming from the square-set portion of the stope. Other methods use square-sets in part, as, for example, in top-slicing where the upper part of the orebody is removed by square-sets.

Methods of mining are constantly being improved, and square-setting has not lost its premier position simply because it has not kept pace with the other systems. In fact, in the last twenty years, great improvements have been made. It is my purpose to call attention to these advances.

UNDERLYING the most important improvements is the recognition of the function of the square-set timbers. The old conception was that the square-sets were put in to hold up heavy ground and actually support it while it was being mined. Now, practical mine operators know that the square-set is not capable of supporting any considerable weight and that it should be used with its limitation in mind. Its present use is dual in that it acts more or less as a scaffold or staging which permits access to the face of ore to be broken. Its other function is to support loose boulders and ground overhead, but, in its more recent application, it is never supposed to support great weights.

In discussing the changes in ideas about square-setting the Copper Queen, at Bisbee, may be used as an illustration. Square-setting there, twenty years ago, was probably more highly developed to meet heavy ground conditions than at any other camp in the United States. This was during the time that it was supposed to be essential actually to hold up and support heavy ground. Twelve-by-twelve timbers were the rule rather than the exception. If a stope started to take weight it was customary to rush in great numbers of auxiliary supporting timbers. For example, the so-called doubling-up set, consisting of a cap and two stull posts, was put in. Likewise, angle braces, diagonal braces, and diamond braces were used, and, if these would not hold, great bulkheads of solid timber were built in. Only a small portion of these timbers were ever recovered.

Another false idea that prevailed respecting square-setting was that unless timbers were absolutely plumb, level, and squared-up properly they did not support weight to the limit of their capacity. To meet these requirements of aligning timber properly in heavy ground, every set was a special set. At that time, timbering was not done by the miner but by expert timbermen whose sole duty it was to put in square-sets. The first thing in the morning a timberman and his partner would come into the stope and measure up for a new set, miners the night before having made room for it. The post had to be exactly a certain length and the cap and tie were also timbers of special length. Careful measurements were made, requiring the services of both timbermen. Often a post would be "flirted"—that is, the position of the horn was changed. The horn on a regular post was in the center, but in a flirted post it was cut the same size but placed nearer one side than the other and often moved in two directions. Instructions for a flirted post might read: "Flirt 1 ½ in. tieway and 1 in. capway." With a 6x6-in. horn on a 12x12-in. timber it was possible to flirt as much as 3 in. A special flirted post required special framing for both cap and tie, as well as a special length for these members. These orders for timber would be sent on top to the framing shed, the timbers would be specially framed, and after several hours' delay would be delivered to the stope. Often the timbermen had to take measurements for one set and immediately go on top, wait for the set to be framed and then bring it down, and set and block it. Under most conditions where the ground was heavy, timber should be placed as soon as possible after the ground has been removed, and it was for this reason that special trips to the surface were required of the timbermen. In really heavy ground, these specially framed timbers were the rule rather than the exception. Regular standard sets were used only where there was no ground movement.

The variety of stope timbers used in those days was greater than now. There were lead cap sills and corner cap sills, lead mud sills and corner mud sills. Cap sills required a horn, and with mud sills no horn was required on the post. There were three different sill-floor posts: the regular post, the flat-bottom post, and the horned post. There were cut-down posts, battered posts, and drop-beveled caps and ties. Fig. 1 is a composite sketch showing the different timbers used. It is not necessary to emphasize the fact that the cost of timber and timbering has been reduced materially by eliminating specially framed timbers. Today, in square-set timbering, special timbers are the exception rather than the rule, and what alterations are needed are made underground by the miner, who now does his own timbering.

THAT it was necessary to make stopes as large as possible seems to have been the old idea. It was not unusual to have a stope seven or eight sets wide, and ten or twelve long, and even longer. In some camps, stories are told that such and such a stope had more than 150 open and unfilled sets on a single floor and that above this floor

This is the first of a series of articles discussing standard mining methods in a manner that will stimulate a study of fundamental characteristics and suggest opportunities for efficient and economical utilization. Mr. Elsing was formerly geologist to Copper Queen Consolidated, and later, for many years, in charge of the geological department and of the mining operations of Cananea Consolidated, prior to acting in a consulting capacity to that corporation.

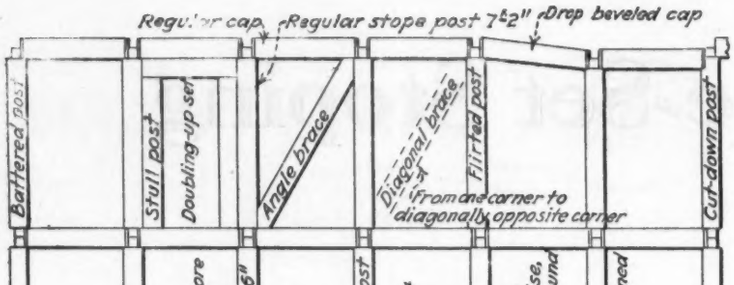


Fig. 1—Composite sketch of stope timbers

there were succeeding floors with a somewhat lesser number of sets, the stope having a total of several hundred open sets. Today, where ground would permit of such large openings without filling, some other method of stoping without timber would be used. Even in heavy ground it was a great mistake to try to carry stope sections too large. A stope five or six sets square was usually considered good practice. Customarily, one floor was mined out practically completely before the next was started.

TODAY, the size and shape of stopes are entirely changed. The best practice in heavy ground is to have the stope not over three sets wide, and in many instances not over two sets wide. The length is of no great importance. In some places, stopes are carried over twenty sets long by two or three sets wide, but, of course, these are never all unfilled and open at the same time.

Change of size has taken place not only in horizontal dimensions but in vertical as well. As soon as possible a second, third, and fourth floor are opened, each of the upper floors being a set or two shorter than the floor below. In the older method, a large, flat, horizontal section of ground was mined and an attempt was made to support the flat, heavy roof on the timbers. In the new square-setting, the roof stands in an arch above the timbers, and, as weight is taken, other sets are immediately taken out and the pressure is relieved. The heavier the ground becomes, the more rapidly must the stope be worked.

In this kind of a stope, filling proceeds continuously so that at no time are there many unfilled sets. In the old method, two floors would be completely worked out, and then the stope would be shut down and the lower floor gobbed. In such practice, it was necessary to fill the sets at a little distance from the waste chute by shoveling and to fill the most distant parts of the stope with wheelbarrows. In extreme cases the stope had to be filled after only one floor had been taken out; in which event what is known as back-filling was resorted to. This consisted in wheeling gob back to the most distant part of the stope and filling up the sets right up to the roof. The process of gobbing was slow and costly, and while it was being done the stope was taking additional weight. In the old system, it took several days to gob a stope, and sometimes much longer. In the new system, gobbing and extraction proceed as a continuous operation.

I freely admit that the long, narrow, rapidly worked stope is the ideal operation, and that much ore has to be mined where conditions obtain which make it impossible to follow such procedure. The new method, as a whole, applies only to new orebodies which have been undisturbed by former stoping. In mining small, irregular sections, so-called "snouts and eyebrows," otherwise the remnants around already stoped orebodies, a systematic method of mining cannot be used. In such circumstances, square-setting is resorted to without any definite plan and the ore is removed in the best way possible. However, even under such conditions the recognition that the proper function of the square-set is not to support weight will dictate a policy of speed in taking out sets and filling if the ground is at all heavy.

Summarizing, the three essentials for the new method of working are long narrow stopes, rapid stoping, and a continuous stream of waste-filling entering the stope. When worked on this basis, the new and the old square-setting systems are very different in their basic principles.

BENEFICIAL RESULTS have been produced by the new method. Ground which formerly could not be held with 12x12-in. timbers and much auxiliary timber can now be worked with 8x8-in. timbers, usually without great difficulty. Occasionally, it becomes necessary to use 10x10-in. timber, but this can often be avoided if the stope is worked more rapidly. The use of 8x8-in. timber in itself cuts the amount of timber by about 50 per cent. When using stope sets of 8x8-in. timber it is customary to use 10x10-in. timbers on the sill floor, and to switch to 8x8-in. timber on the second and subsequent floors. In some camps 6x8-in. ties are used, whereas at Globe the tie is only 5x8 in.

Much less difficulty is experienced in handling and placing the smaller timber, and consequently not only the cost of timber but that of timbering is greatly reduced.

The new system includes the use of ore slides to eliminate most of the shoveling, when so desired. Such slides are used when the ore is of uniform grade; when it is desirable to resort to hand sorting, however, the slides can be removed and a horizontal floor established, permitting sorting and throwing the waste into the open sets below. This is a flexible feature of the stope and can be used at pleasure.

Thus, little handling of gob filling is required in the stope. The waste is dropped into the stope through the raise driven to the level above, and more or less fills the stope without wheelbarrow work and with little shoveling. When worked in this way, the stope closely resembles the incline cut-and-fill stope when the latter is worked in rill fashion. The one difference between the two stopes, of course, is in the timber used. In the incline cut-and-fill the gob is dropped into the stope from above, after which an incline floor is laid on the gob. The ore shot down on to this floor slides down to the grizzlies over the ore chutes. The advantages of the method are that it calls for little handling of waste filling and little or no shoveling of ore.

THE same principles are applied in mining ore from the square-set stope. In this case, the incline floor is placed on the set timbers a few feet above the gob. Remove the square-sets and one finds that the shapes of the cut-and-fill stope and the square-set stope are identical, that the method of introducing waste filling is precisely the same, that the method of breaking the ore varies slightly, but that its delivery to the ore chutes is accomplished in the same way.

The name "incline square-setting" has occasionally been applied to this modification of square-setting. The designation of "incline cut-and-fill" describes such a stope precisely. However, when the term "incline" is applied to square-setting, it is somewhat misleading, as it might imply that the sets themselves are inclined. A more satisfactory name would be "square-setting by incline," or, better yet, "rill square-setting."

Assuming that an orebody of some considerable size has been blocked out for extraction and that the decision to use square-setting has been made, one must then decide on a plan for laying

out sections. It is important that a definite plan for the complete extraction of the orebody be established. As to the best way to do this opinion differs. In one factor only is there more or less complete agreement, and that is that sections should be transverse to the long dimension of the orebody. In the case of a vein, sections should run from footwall to hanging wall. Here agreement ceases. Some operators believe that stoping should be started at one end and mined in progressive sections to the other. Some advocate starting in the middle with a transverse stope and then working progressively toward both ends. Others advocate the laying out of sections with pillars between. My own opinion is that the most satisfactory method is to lay out a transverse section entirely across the orebody in its center and follow this with parallel sections on both sides, working toward both ends of the body. The advantage of this is that the capacity of the orebody to produce has been doubled. This layout will, perhaps, require a few "run-around" drifts to make the farther sections accessible to the main haulage lines, but the advantage of a large possible production more than offsets this. If production is not an important consideration, the starting of stoping at the farther end of the orebody is probably best.

The stope-and-pillar method of mining is highly undesirable. As a matter of fact, I detest the task of mining pillars left by any method, except of course in caving methods. The mining of the original stopes is certainly easy. Everything works without a hitch, but when one comes to extracting the pillars, operations are entirely different. If the whole country has taken weight, but one really satisfactory method is left and that is the top-slicing of the pillars. If the orebody and surrounding wall rock are of such a character that stoping may cause them to become really heavy, then evidently a mistake was made originally in not adopting top-slicing as the method of mining the entire orebody. In other words, if the evidence indicates that top-slicing will have to be resorted to in mining the pillars, top-slicing should preferably be adopted for mining the entire orebody.

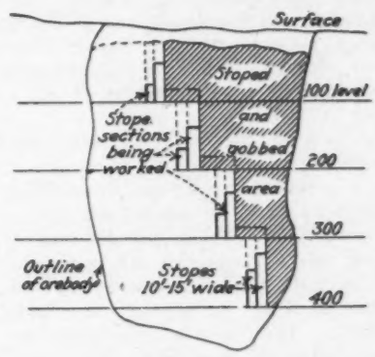
MINING OF STOPE PILLARS is a big subject in itself and perhaps does not belong in a discussion of square-setting. However, it has such an important bearing on the laying out of stopes that it should be mentioned. If the ground is of such a character that square-setting was originally the proper method, there are but two alternative methods for mining the pillars—that is, by square-setting or, as already mentioned, by top-slicing. If square-setting is employed, and the ground is heavy, the difficulties are really tremendous. As an illustration of what often happens, let it be assumed that the orebody is 100 ft. wide and 100 ft. high and that the pillars are from 25 to 50 ft. wide. By the old method, a section would be taken out at least 25 by 25 ft. This would be carried up vertically. The result would be that the pillar would be cut off on a third side. General ground movement would be started by this time if the original sections had not already started it, with the result that the pillar of ore would break away from the other wall. It could not hang as a pendant, and the ultimate result, in heavy ground, would be that the whole dead weight would rest on its base. As part of the base was removed, the remaining part would crush and the weight would be transferred to the stope timbers.

By the latest methods of square-setting such a pillar, narrow slabs, so to speak, would be sliced off it—that is, a narrow section not over two sets wide would be carried up and the gob would have to be carried very close to the timbers. Another alternative method could be applied. This would be by underhand square-setting. In this case, square-setting would be carried down instead of up. This is much more expensive, but under certain conditions it is the only alternative. The method has some of the same characteristics of top-slicing, except that the set is gobbed and the gob and set are then held up with timber immediately below it. This prevents the caving of areas overhead which always accompanies top-slicing.

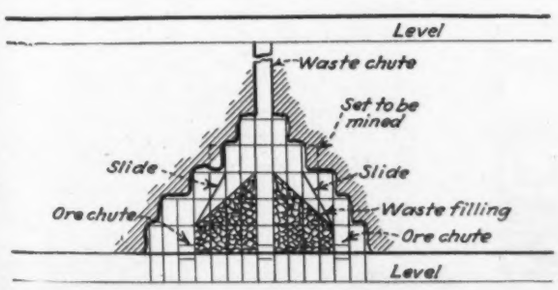
When ground becomes heavy, great difficulty is experienced in maintaining drifts on the level above through which waste is delivered to the pillar square-set stopes. Proper ventilation is also more difficult for this reason. Fire hazards with pillars are much more serious. Fires may actually be started by the movement of pillars causing such heat that combustion takes place. As evidence for such a statement, reference is made to a fire many years ago in the United Verde Extension which was started by the movement of a mass of practically barren pyrite. After the fire was extinguished, rather than leave sulphide pillars the company mined them to remove this fire hazard. If a pillar does not actually start a fire, its movements always cause the generation of a great deal of heat, which is highly undesirable. If a fire does start in the vicinity of a pillar, there is no more difficult task than trying to extinguish it and mine the pillar at the same time, and by so doing to show a profit.

TO SUMMARIZE the question of leaving pillars between square-set stopes, the problem becomes purely economic. The total cost of mining the orebody is the average of the cost of mining the original stope and the cost of mining the pillars. There is no question that mining ore from a square-set stope is more economically done where all walls are either solid ore or country rock than where one side or more than one side has been already mined. In other words, where pillars are left, the cheapest ore comes from the original stopes and the highest-cost ore from the pillars. The average of these costs represents the cost of mining the whole body. I have never been able to collect satisfactory cost figures to show this and to substantiate the contention that mining with pillars between square-set sections is nearly always inadvisable. My statement is based on personal experience in mining stope pillars in general. In one instance, over 100,000 tons of ore was recovered from an old square-set-and-pillar stope. In this area six square-set stopes about 100 ft. long and 50 ft. wide had been laid off across the orebody. Stope pillars, 40 ft. wide, were left between the stopes. No serious difficulty in mining the original stopes was had. Trouble did not begin until square-setting of the pillars was started. With the bases of these pillars cut off, the whole country started to move. General subsidence of the ground over the stopes and pillars began, which finally worked its way to the surface, where the movement manifested itself by the opening of cracks.

The ore was comparatively soft and contained some clay. After less than



Ideal longitudinal section illustrating progressive stoping on different levels



Sketch showing a rill square-set stope

half of the pillars had been recovered by square-setting the pillars simply crushed down under the enormous weight of the overburden. In most places a raise could not be driven to the level above and be kept open for the passage of waste for gob fill. Stopes and drifts closed up, the timber breaking and folding up like the blades of a jackknife. Level drifts were held open only where timbered with solid timber bulkheads. This happened two or three years before top-slicing had been introduced into the Southwest, and so there was no alternative method to fall back on. Some of the remaining pillar ore was recovered by drawing it from chutes and caving it, and much more was recovered years later by top-slicing, but a great deal was hopelessly lost. This is perhaps an extreme case, but it illustrates what nearly always happens to a lesser degree when mining soft high-grade ore pillars.

In the past, the principal reason for using the pillar-and-stope method was that it provided more stopes from which production could be maintained. As a matter of fact, with the present square-setting this advantage is not so important, because greater tonnages can now be produced per square-set stope than formerly. The old horizontal square-set stope, when fill was being introduced, had to be shut down and produced no ore until the stope was completely filled. On the average, no ore was being produced almost half of the time, whereas with much of the recent square-setting practice, extraction and filling are going on simultaneously. On this basis alone, for the same daily tonnage, only half the number of stopes are now required, and, in addition, the present stopes can be made to produce greater tonnages per stope.

If the original section is taken across the middle of the orebody, it will not have to advance very far before sections on both sides can also be started and these may soon be followed by other adjacent sections. By this arrangement of stopes a large tonnage may be produced from a comparatively small area.

IN MINING comparatively soft ground, where the ore column is vertical and attains a thickness of several levels in vertical extent, another matter of a character more or less similar to that of the question of stopes and pillars must be considered. As a specific illustration, one may assume such an orebody bottomed on the 400 level and extended almost to surface, and, as another illustration, that of an orebody bottomed on the 1,000 level and extended vertically to the 600 level.

The question as to where stoping should be started is open to argument. Probably, preferred practice would warrant doing so on the 100 and 700 levels and more or less complete the extraction above these levels before starting on the 300 and 800 levels. To follow the best mining practice is not always possible. The demand for tonnage must be met, and if other orebodies cannot supply enough to keep production at the desired rate, it becomes necessary to devise means by which greater tonnage can be produced from a given orebody without serious results to the later operations. By properly arranging stopes, all four levels can be made to produce at the same time. Assume that stoping on the upper level has been started at one end of the orebody and that stopes are being worked progressively toward the other. Then by starting stopes on the level below from the same end of the orebody, new sections will be brought up under the worked-out sections above. By keeping these sections in step fashion from level to level—that is, with the stoped areas smaller on each deeper level—the minimum effect caused by the inevitable settling and consolidation of the gob will be registered on the producing areas on levels above.

Probably, the most difficult section to mine is that portion just below the stoped area on the level above. In other words, the most difficult section to mine is the 20 or 30 ft. of ore lying below the level, the point where the lower stope breaks through to the upper level stope which has already been mined. Progress here must be very slow, as the greatest care must be taken to prevent caving. That when such a stage of operations has been reached the whole foundation and base of the upper stope is being undermined is perfectly evident. It is for this reason that before the "breaking-through" stage arrives, the stope above should be completely finished.

A good way to make this "breaking-through" period less hazardous and to better protect and keep open the level drifts is to keep the sill floor intact. In other words, stoping should be started on the second floor and the sill left in place. The mining of the sill floor is then accomplished as the last step in the mining of the stope on the level below. The "breaking-through" process, in this case, is the mining of the sill floor.

In most mines where square-setting has been done in heavy ground, old stoped areas have been re-mined two and sometimes three times. In part, this has been due to the lowering of treatment costs making possible the mining of lower-grade ores. However, there are other reasons why the re-mining of these old gobs in many instances has been so profitable. The main one is that in years gone by, mining was not nearly so complete and thorough as today. The more or less haphazard laying out of stopes was not conducive to complete extraction. Pillars were only partly recovered, and as stopes were advanced toward the level above they became heavier and were not infrequently lost. I have proved this to my own satisfaction diagrammatically.

For example, a vertical cross-sectional diagram was made through a uniformly shaped orebody which had been stoped. By plotting the number of square-sets mined on each floor, one finds that the diagram showed that the lowest floor contained the greatest number of sets, and, as progressively higher floors are reached, the number of sets becomes less and less until the level above is reached. The diagram for one level will have the approximate shape of a truncated triangle with the larger base on the level. As the diagram is carried up above the next level, the same condition is repeated.

THE completed diagram shows a series of truncated triangles one above the other. In terms of tonnage this implies that the maximum was mined on the sill floor where recovery was the easiest. As stoping advanced upward, the tonnage mined on successive floors became less and less until the next level was reached, above which there was a repetition of these conditions. Other conditions being equal, there was just as much ore one floor below a given level as on that level and, therefore, just below the level is the place where most ore is lost, or, to say the least, is un-mined.

The conclusion from the reasoning in the foregoing is that if a search is to be made for this lost or un-mined ore, an intermediate level, say, 30 ft. below the main level, will be at the most productive elevation. I have seen this proved repeatedly. Such conditions refer mainly to the oldest stoped areas, and do not occur today. This is in part to be attributed to the fact that stope engineers for a good many years have kept close records of ore conditions, not only recording each set mined and the grade of the ore and the grade of section and dead-line sets, but also of geological conditions. This supervision is one of the big advances in the new square-setting and has been an important contributor toward its improvement.

Again I reiterate that if the true function of the square-set is borne in mind, and operations are carried on accordingly, timber, labor, and ore can be saved, resulting in remarkably low costs. The method has so many advantages that offset the slightly greater cost per ton that it will always hold the important position among mining methods that it now possesses.

Mining Opportunities in Known Districts

E. E. Erich

San Francisco

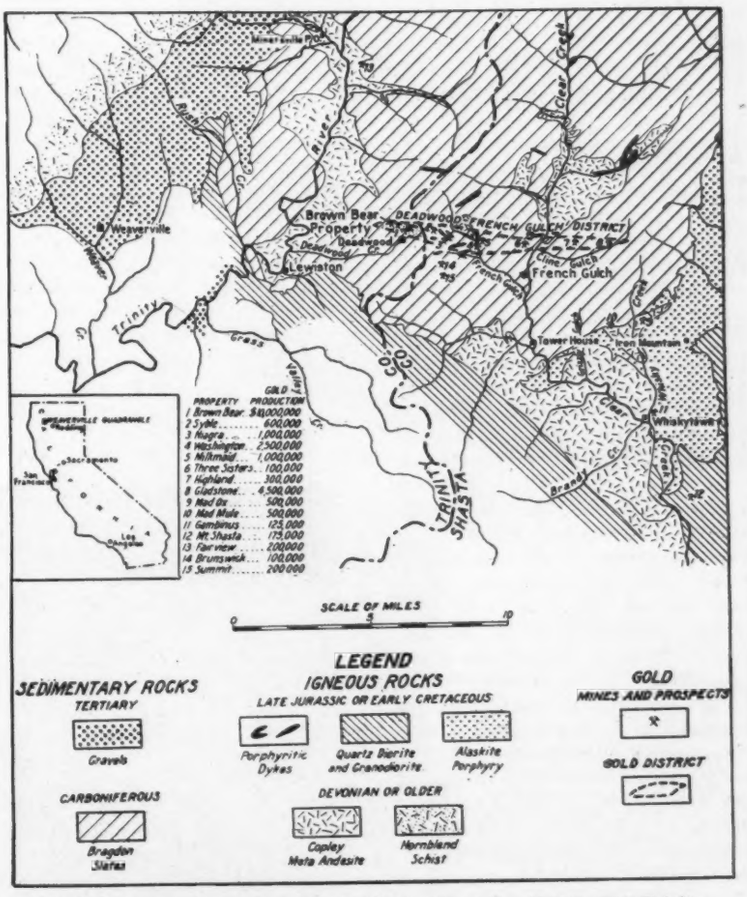
AN EXTENSIVE search for mining opportunities leaves me with two definite impressions: First, most of the obvious deposits have been found and explored, leaving, with few exceptions, only those that are obscure or difficult and expensive to investigate. Second, the place to look for ore is where important ore has already been found. One usually has a good chance in such a locality to uncover an opportunity by sifting from the abundant information available those vital data that may lead to the development of additional ore.

The following account illustrates a specific case and gives the results of an investigation that was carried out according to the recommendations implied by the conclusions given. The locality investigated is known as the Deadwood-French Gulch district, an isolated gold area of northern California, highly productive in the early days of California gold mining but showing little activity subsequently. The district is confined to a narrow strip about eight miles long and one mile wide, from which gold valued at $20,000,000 has been produced. Productions from individual mines of the district range from a few hundred thousand to eight million dollars in gold. Most of the development work has been through tunnels.

Extensive surface workings and tunnels which are accessible reveal that numerous small, high-grade, gold orebodies were found and mined. Several outcropped at the surface and were followed down. Also, a number of orebodies were found underground of which no indication existed at the surface. The localization of ore was apparently not well understood, which accounts for the extensive workings carried on in barren ground and for the numerous gold strikes made in abandoned workings by subsequent lessees and individuals who followed up faint traces of gold.

Geology—The principal rocks of this district are slates (known as the Bragdon Formation), andesites (known as Copley Meta Andesites), and porphyries of the soda-granite and diorite-porphyry variety. The slates vary in character from soft, black, and graphitic, to hard, siliceous, and blocky. Intruded into the slates and andesites are the porphyries, in large, irregular, finger-like masses and dikes. Extensive fissuring of these rocks has occurred, and it is along some of these fissures that gold-bearing solutions have passed, leaving traces and concentrations of gold in the veins and fissures throughout the area. Gold concentrations are chiefly confined to cracks or veins. The ore is of medium and high-grade variety, varying from $10 to $1,000 per ton. Sulphides, between 1 and 4 per cent of the ore, consist principally of pyrite, with minor amounts of galena and sphalerite. The gangue is quartz.

Some veins can be traced from 1,000 to 3,000 ft. They parallel and also cut the inclosing rocks at acute angles, in both strike and dip. They pinch and swell abruptly. In the expansions of the veins the filling is usually quartz, and at the ends or contractions the quartz filling becomes more an admixture of slate or porphyry or both, and finally pinches down to a gouge-filled fissure. The ore, which occurs in shoots, generally short, usually extends short distances beyond the point of concentration along the localizing veins or fissures. These shoots vary in pitch, depending on the dips of the intersecting veins that localize the ore. Intersections and branching of veins undoubtedly favor the concentration of ore; however, not all intersections or junctions localize ore. The effect or importance of the wall rocks on ore localization is not well understood; however, where the wall rocks are



PROPERTY	GOLD PRODUCTION
1 Brown Bear	$8,000,000
2 Sykle	600,000
3 Niagra	1,000,000
4 Washington	2,500,000
5 Millmaid	1,000,000
6 Three Sisters	100,000
7 Highland	300,000
8 Gladstone	4,500,000
9 Mad Gir	500,000
10 Mad Mule	500,000
11 Gambrinus	125,000
12 Mt Shasta	175,000
13 Fairview	200,000
14 Brunswick	100,000
15 Summit	200,000

Geologic map of part of Weaverville Quadrangle, Shasta and Trinity counties, Calif., showing position of principal lode-gold mines; also the Deadwood and French Gulch districts, containing most of the important gold mines of the quadrangle.

dissimilar, the ore is of higher grade than when the wall rocks are similar. An explanation of the possible origin of the gold ore, conforming with the ideas expressed by Adolph Knopff in his Mother Lode paper (Professional Paper No. 157, U. S. Geological Survey), is given as follows:

The gold probably came from a deep-seated granitic magma. The quartz came largely from the inclosing wall rocks, and the water by which these substances were carried in solution came partly from the magma and mostly from meteoric sources. Gold and other constituents, chiefly sulphur, lead, and zinc, were probably supplied by exhalations that issued at high temperature from the deep-seated magma. The exhalations condensed as water that carried the gold and other metals dissolved in it. This magmatic water circulated along paths which were determined by fissures. Many fissures were filled with this magmatic water; however, only those portions of fissures through which gold-bearing solutions were actively flowing became loci of gold deposition and eventually oreshoots.

Investigation of the district definitely indicates that vein intersections and branching of fissures are important loci of gold deposition. These distinct types of intersections were observed: (1) Intersections of two gold-bearing veins. This type of intersection localized all the important orebodies I examined. (2) Intersections of one gold-bearing vein and a barren vein. This type of intersection localized several small orebodies, but, so far as is known, did not localize any orebodies of importance. (3) Intersections of two barren veins. This type of intersection usually does not localize ore.

The assumption that vein intersections or junctions are favorable points for ore concentrations, and that larger concentrations of gold are more likely to exist when both intersecting veins are gold-bearing, provide a definite and simple guide to ore, by which it is possible to appraise unexplored parts of the district and unexplored areas of individual properties on a new basis. This involves detailed mapping, to determine the directions of fissures and locations of possible vein intersections. Obviously, properties with extensive accessible workings are the easiest to investigate. The chief considerations in the application of the determined guide to ore are size and grade of ore and cost of exploration. Upon these considerations, the Brown Bear property, with a production record of $8,000,000, the largest producer of the district, was chosen as the best opportunity on which to carry out detailed investigations. Three of its individual orebodies each produced in excess of $1,000,000 in gold.

At the Brown Bear the gold occurs in veins and fissures within an area of slate, which has been cut and intruded by porphyry masses and dikes. The veins lie at varying angles but with a general east-west trend. They are mostly soil-covered, outcrop only in a few places, and have been mined to comparatively shallow depths by tunnels. The greater portion of production came from what is known as the Monte Christo and Last Chance veins, explored 2,600 ft. along their strike and extensively mined to depths of 400 ft. Small portions of these veins have been mined at depths of 760 ft. below the surface. Several smaller veins exist in the property. These have been explored near the surface and have produced important amounts of high-grade ore.

Both the Monte Christo and Last Chance veins are strong fissures, varying in width up to 20 ft.; however, in places they contract to a few inches of gouge. The ore mined varied up to 20 ft. in width and averaged between $20 and $100 gold per ton, not uniformly distributed throughout the veins, large portions of which contain only lean gold values. From the extensive work done in the upper mine workings, the search for orebodies in the veins was evidently no simple task. Development work was most extensive where it was cheap and easy to explore. The gold found apparently varied in proportion with the amount of work done.

The Watt tunnel, 350 ft. below the lowest upper tunnel, had been driven 6,000 ft. by the previous operators into the general vicinity beneath the orebodies of the upper workings, and was then abandoned. This tunnel, made accessible and studied in detail, was found to have cut numerous fissures and veins, some containing gold, and some having similar and some dissimilar wall rocks.

In order to proceed effectively, a resurvey of the accessible mine workings had to be made, additional maps prepared, and the geology of these workings recorded in detail. Some of the more important workings had to be made accessible. The results of this work determined the approximate locations of seven possible vein intersections, all within easy reach from the Watt tunnel level. The upper workings of the mine also were found to contain several attractive opportunities for reaching vein intersections. Some of these possible intersections occur within short distances of the main haulageways.

Extensive areas of this property exist, as well as large and unexplored portions of other properties in the district. Little is known regarding these areas. In a few places they have been scratched on the surface, and gold has been found. These areas represent favorable prospecting ground, which probably contains important vein intersections and possibly important orebodies.

Conclusions—Extensive investigation of the district has determined that vein intersections (or junctions) and branching of fissures are favorable loci for gold concentrations. When each of such veins is gold-bearing, important orebodies have been localized. When only one is gold-bearing, smaller and less important orebodies have been localized. Intersecting veins that are barren of gold usually do not localize ore.

The effect or importance of the wall rocks on ore localization is not well understood; however, where the wall rocks are dissimilar, the ore is of higher grade than when the wall rocks are similar.

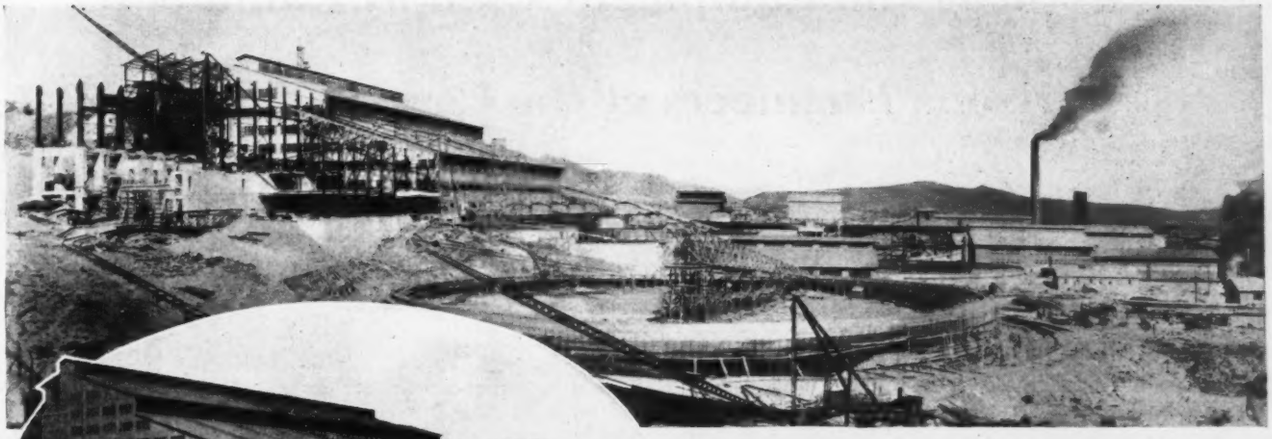
A careful search for possible vein intersections in areas easy to explore may result in the discovery of a number of large and important orebodies with comparatively little effort.

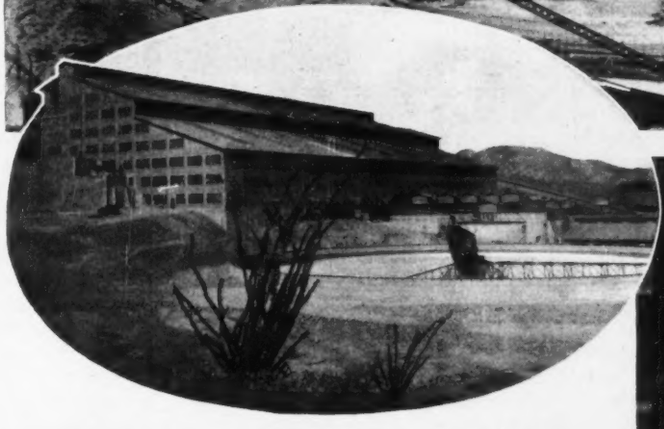
The application of the determined guide to ore makes possible the prediction of new opportunities for properties of the district that were thought to be exhausted.

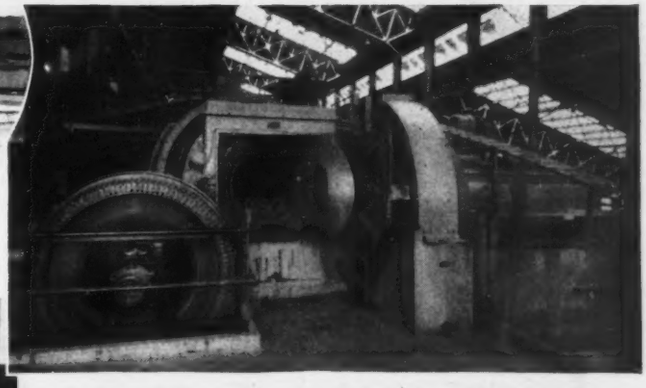
■ ■ ■

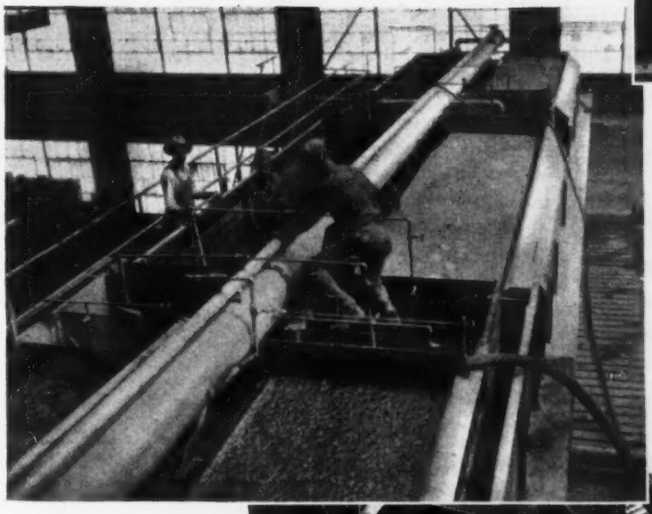
A loaded ajojo (canoe) sinking in a river rapid, Bahia, Brazil. The traveler watches, in some comfort, while natives salvage part of the endangered cargo.

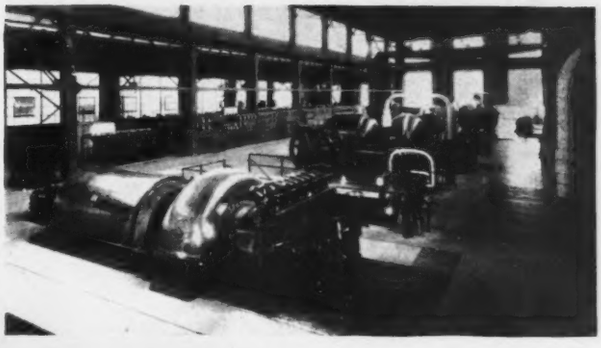
New Cornelia Mines Division of the Calumet & Arizona Mining Company Improves Plant Facilities



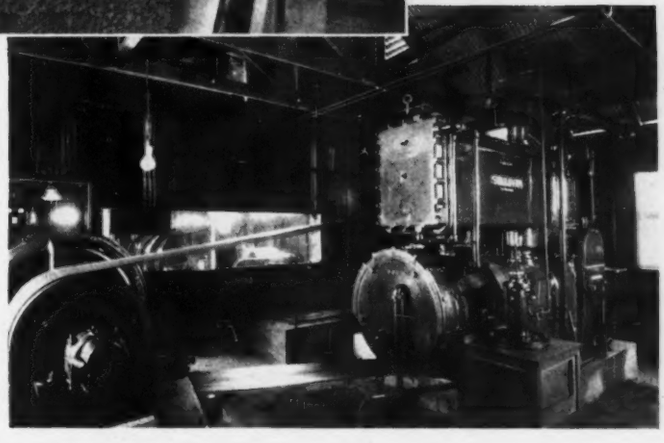








Above, power-house interior. Turbo-generators supply all power demands.



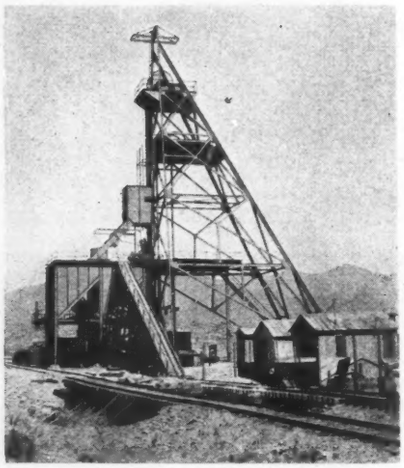
At right, compressor equipment at New Cornelia open pit.

At top of page, new construction at Ajo; steel and reinforced concrete. Concentrating mill as extended, and a new tailing dewaterer installed. In oval, completed mill. Middle right, lengthened Marcy rod mills. Middle left, new flotation cells.

Shaft Concreting in Arizona

Methods and Equipment Used by Calumet & Arizona Engineers at the Campbell Shaft

George J. Young
Associate Editor



Headframe and surface plant at the Campbell shaft

THE Campbell shaft of the Calumet & Arizona Mining Company is between the Junction shaft at Lowell, Ariz., and Warren. It was sunk ten years or more ago, but was not completed, and the Campbell area, which was then being developed, was served by the Junction shaft. Recently, the Campbell shaft was sunk to 2,360 ft., and concreting, which had reached the 1,600 level, is now being completed between the 2,340 level and the 1,600—a vertical distance of 740 ft.

Both the Junction and the Campbell shafts are downcasts and main working shafts. With the completion of the work in the Campbell shaft, the underground area will be served by two modern shafts, concreted throughout their depth. The upcast shafts, the most important of which are the Briggs and Cole shafts, are all timbered. Saginaw shaft, east of the Campbell, is being sunk to the 1,800 level and will be concreted throughout. This new shaft is to be a main upcast. Campbell shaft is round-ended, the portion between the ends being almost square. The inside length is 11 ft. $3\frac{3}{4}$ in., and the width 10 ft. 8 in. Including the curved portions, the inside length is 15 ft. $3\frac{3}{4}$ in. Radius of curvature of one end is about 8 ft. 4 in., and of the other, 6 ft. 2 in. The shaft is divided into three compartments: two for the skips, each of which measures 5 ft. x 4 ft. $6\frac{3}{4}$ in., and a large cage compartment, 5 ft. 3 in. x 10 ft. 8 in. An 8-in. concrete partition separates the cage from the skip compartments, which in turn are separated by an 8-in. wall. The curved ends increase the cross-section of the shaft and probably contribute to its structural stability, besides providing a larger area for ventilation purposes. In Fig. 1, section *DD* shows the cross-section of the finished shaft. Section *BB* and section *AA* show the method of timber support. The two smaller compartments are lagged at the ends, and brattice partitions are carried down for purposes of ventilation and for the protection of the hoisting compartments during sinking.

A plan view of the steel forms used in concreting is shown in Fig. 2. The length of a guide section is 20 ft., and the vertical height of the form is 6 ft. 8 in., so that three forms will just make the height of a $5\frac{1}{2}$x$7\frac{1}{2}$-in. x 20-ft. guide. The forms for each compartment are hinged together at each corner angle, and the metal wall of the form is $\frac{1}{4}$ in. in thickness. Each section of a form is strengthened by vertical angles at the edges and by horizontal 3x3x$\frac{5}{16}$-in. angles at top, bottom, and two intermediate positions. In addition, at both top and bottom edges are bearing angles of the same size, by which the ring sections are supported one on top of the other. The form for the cage section consists of four parts, hinged together. Two forms are necessary to make the complete periphery of the vertical section. The break is at the guide timber on the transverse concrete partition separating the compartments, and at the apex of the curved section the two forms are bolted together. The forms for each skip compartment are in two parts divided by the guides on either side. Each part consists of three pieces hinged at the corners, as shown in Fig. 2. Rings are provided for handling purposes. The forms are carefully made and are as rigid as possible. Edges of abutting segments are milled so as to make a tight joint; rivets are countersunk on the face next to the concrete.

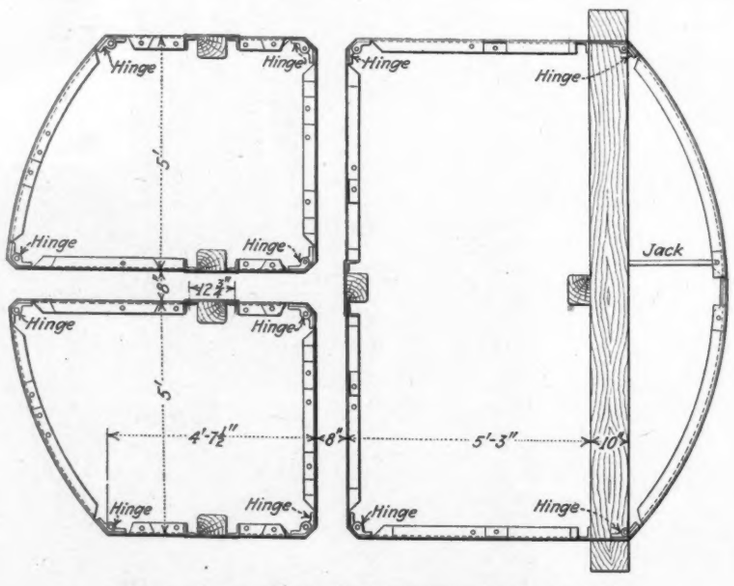


Fig. 2—Arrangement of steel forms used in concreting

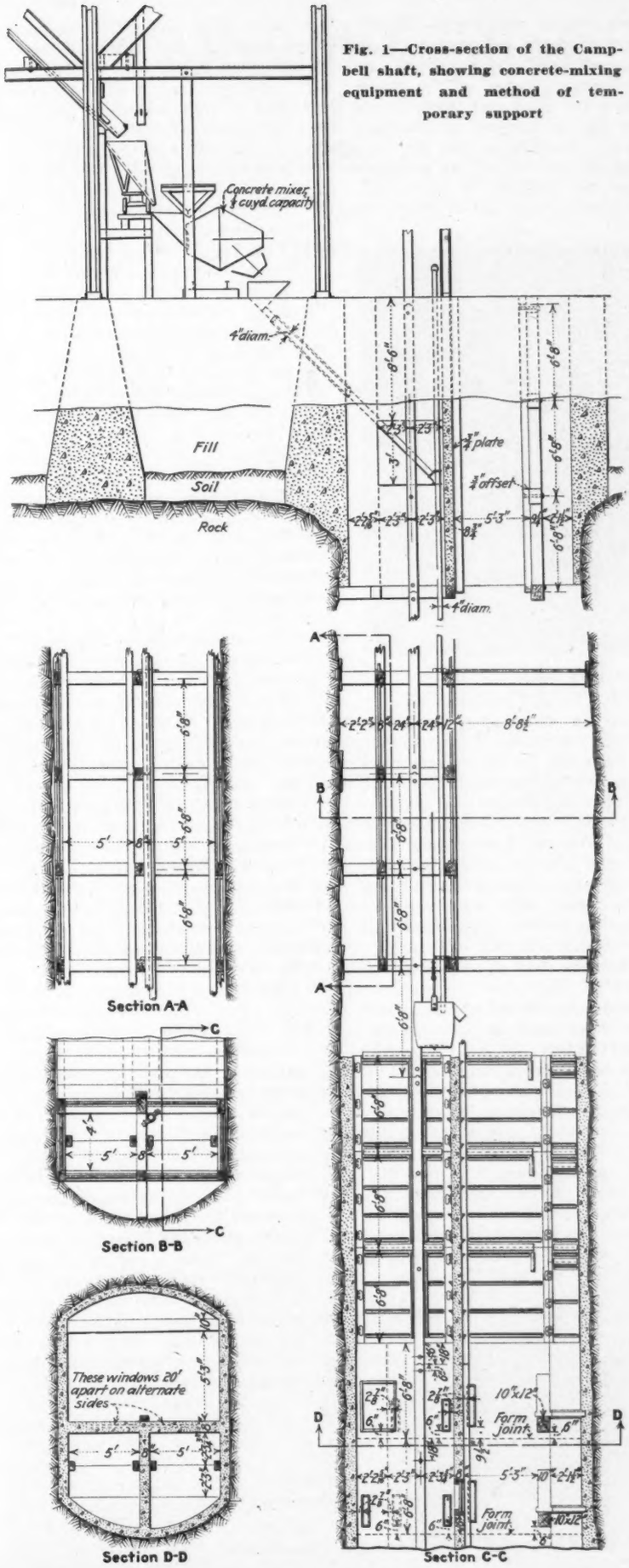


Fig. 1—Cross-section of the Campbell shaft, showing concrete-mixing equipment and method of temporary support

Cast-iron receptacles, as shown in Fig. 3, are provided for receiving the bolts for the attachment of the guide timbers. Each 20-ft. section of 5½x7½-in. guide is secured by four ⅞-in. bolts. Two types of receptacles are made: a double receptacle for the 8-in. partition wall between the skip compartments, and a single receptacle for the outer walls of the skip compartments and for the transverse partition separating the skip and cage compartments. The form of the receptacle is that of a truncated wedge, providing a large bearing area upon the concrete. Short pieces of reinforcing steel are placed through the holes in the projecting lugs of the casting. The detail of the castings is well designed and should give excellent service. Three complete sets of steel forms, costing $5,000 to $10,000, are used in concreting. Although heavy and more or less difficult to handle, they have the advantage of rigidity and freedom from

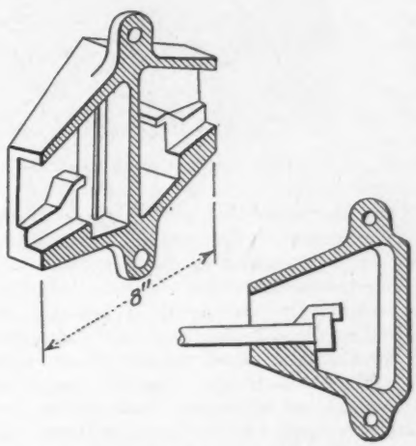


Fig. 3—Sketch of single and double cast-iron receptacles for guide bolts

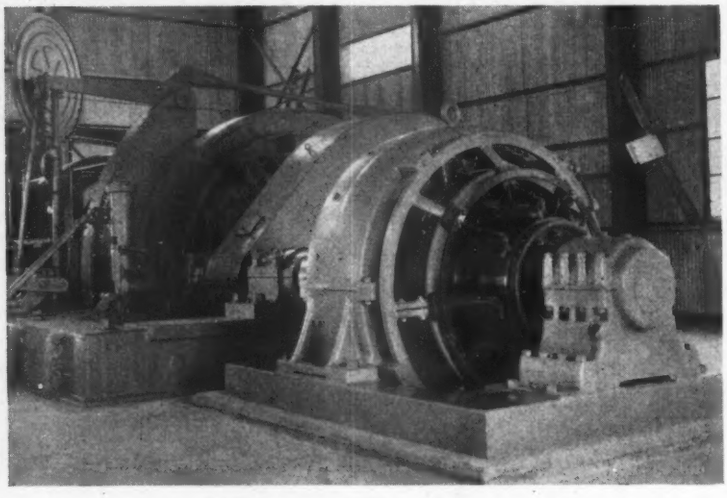
breakage. Use of such forms follows the practice established in concreting tunnels.

The layout of the concreting equipment is indicated in Fig. 1. Bins, served by an incline and hoist, receive the crushed rock, sand, and cement. A transfer car in front of the bin gates receives and measures the materials and delivers them to a ½-cu.yd. concrete mixer. The product from the mixer passes to a hopper connected with a 4-in. pipe in the shaft. This pipe discharges into a bucket, from which the concrete is poured or spouted into the forms. As will be noted in Fig. 1, the lower edge of a form is placed 18 in. above a junction of the guide timbers, and the upper edge of the three forms projects 18 in. above a junction. Guide timbers are lined in place, and, inasmuch as the edges of the forms abut against the sides of the guides, the closure of the space to be filled with concrete is accomplished.

In the skip compartments, the forms on each side of a corner are braced and held in position by bars, the bent ends

of which are placed in holes in the top angle reinforcement. The bars, being of fixed length, place the contiguous parts of the form in exact position and also act as braces. A similar arrangement is used in the cage compartment. In the case of the two forms which make the curved end of the shaft, a special jack is used as a brace.

Openings or windows, 20 ft. apart and on alternate sides of the guide of the cage compartment, are left in the dividing wall separating the cage and skip compartments. In addition, windows are left in the partition between the skip compartments on each alternate form. The windows are 30 in. wide and 42 in. high. Sockets (scaffold boxes) are left in end walls and in partition walls of the skip compartments, on a line 6 in. above the lower edge of each form. These sockets are 26 in. high, 7 in. wide, and 6 in. deep. Sockets are also provided in the walls for the 10x12-in. divider in the cage compartment. These sockets are on the same horizontal line as the sockets in the skip compartments and are 48 in. high, 10 in. wide, and 6 in. deep. A horizontal groove, 3 in. wide at the bottom, 4 in. deep, and 6 in. wide at the inside edge, is placed in the curved section of the cage compartment, at a point corresponding to the top of the divider. The groove is formed by a wooden piece bolted to the steel form. Sockets are also placed in the side walls of the cage compartments, $2\frac{7}{8}$ in. in front of the partition wall. The sockets are used in connection with the concreting operations in the cage compartment as receptacles for supporting timbers, upon which a platform is carried beneath the three sets of steel forms. After a top form has been set in place, a platform is constructed and supported upon the reinforcing angles of the forms; the forms are filled and tamped; and then the shaft is stripped for the next form above. Sockets in the skip compartments are put in only for emergency use after the shaft is in operation. The crossheads used in the skip compartments are constructed so as to pass through the forms. Forms to be moved are taken off, set on the crosshead platform, hoisted to the proper elevation, and placed in position.



Main hoist and 1,350-hp. driving motor

At the Campbell shaft two eight-hour shifts, separated by four-hour intervals, are employed in concreting. A six- to eight-man crew is required, and two men during the four-hour interval place braces and make ready for the regular shift. In this way 13 ft. 4 in., or the equivalent of two rings, is completed in 24 hours. A regular shift-crew usually comprises six men. The proportions used in the concrete are: 1 part cement; $2\frac{3}{4}$ parts sand; and $4\frac{1}{2}$ parts broken rock, or about a 1:3:5 mix. No reinforcing is used except at the guide bolt receptacles, each of which has two short pieces of reinforcing steel. The minimum wall thickness is 6 in., the maximum 3 ft., and the average about 18 in., depending upon the amount of overbreak in the shaft section.

The Junction shaft was concreted with wooden forms, the form height being 5 ft., or four rings, for a 20-ft. vertical stretch. Planks, $1\frac{1}{8}$x12 in., were used, together with steel plate and angle reinforcing. The work was divided into three eight-hour shifts, and forms were filled at any time when they were ready. Wooden forms have the advantage of lightness and can be handled by the men. A composite form constructed of steel and timber warps and shrinks when not in use but is otherwise satisfactory.

Concerning maintenance work, I was told that until 1913 the Junction shaft required a repair crew, but that after this date, when the shaft was concreted, the first repair work necessary was in 1928, or after an interval of fifteen years. In this shaft the wall pressure is greatest in the vicinity of the 2,200 level. The weakest element in the shaft lining was the partition or divider. This was reinforced by 6-in. I-beams, weighing $17\frac{1}{2}$ lb. per foot, with welded-on "head boards" placed at $2\frac{1}{2}$-ft. intervals wherever side pressure manifested itself on the old lining. The only other feature was the erosion below the shaft pockets caused by falling ore. After about sixteen years this had reached a condition that made repairs necessary. The shaft is in a limestone country rock, and, inasmuch as the concrete runs back into the seams, an effective seal results and all weathering action is stopped.

Two hoists are in use at the Campbell shaft. The sinking hoist is an Allis-Chalmers double-drum, with center-gear friction clutches and hand-operated brakes. It is driven by a 200-hp. motor and is equipped with 1-in. steel rope. The main hoist is electrically operated; has two drums, 10 ft. by 7 ft. 6 in.; a single reduction Falk gear drive; 34,000 lb. maximum rope pull; and a 2,000-ft.-per-minute maximum hoisting speed. The skips weigh $5\frac{1}{2}$ tons, and the maximum hoisting depth of the installation is 3,500 ft. A 1,350-hp., 550-volt, direct-current motor drives the hoist and receives current from a motor-generator flywheel set. The motor is rated at 1,000 hp. and generator at 1,250 kw., 720 r.p.m. The flywheel, weighing 31 tons and 12 ft. 8 in. in diameter, is mounted at the end of the set and is attached to the shaft by a Falk coupling. This provides for throwing the flywheel out of service when the hoist is to be used for light duty. A liquid controller is used for the induction motor, and a Cutler-Hammer control board for the hoist. The switchboard arrangement provides for limit speeds of 800, 1,200, 1,600, and 2,000 ft. per minute. The hoisting rope is $1\frac{3}{8}$ in. in diameter. Overwind stops, electrically operated, are provided. The hoist is installed in a structural-steel building covered with galvanized iron. A traveling crane is included among the equipment housed in the building.

Rock Asphalt Mining

A road constructed of the mined product, at Spring Canyon, Carbon County, Utah

Gail Martin

Salt Lake City, Utah

NEAR Sunnyside, Utah, at the crest of the Book Cliff Mountains, and enterprise has been started that has for its objective the conversion of a mountain of rock asphalt into many thousands of miles of highway pavement.

Early in the history of Utah, pioneers in the territory now embraced in the state discovered vast deposits of bitumen. Attempts were made to exploit these resources. In 1891, Commercial St., in Salt Lake City, was surfaced with rock asphalt; in 1896, Second South, between West Temple and First West; and, in 1895, Richards St. In 1905 a ¾-in. layer was laid on bare dirt around the City and County Building in Salt Lake City. These pavements are now in as good conditions as when first laid.

Engineers and financiers who considered exploiting the deposit now being developed by the Utah Rock Asphalt Company faced insuperable difficulties that forced them to retire from the field with heavy losses. A rugged terrain, which rises nearly 3,000 ft. above the Denver & Rio Grande Western Railroad terminal at the coal camp of Sunnyside, defied all ordinary methods of transportation. To overcome this handicap, mining had to be conducted on a large-tonnage basis. At that time a market sufficient to justify operations of this type did not exist and could not be developed by inadequately financed companies.

Events of the last few years, however, have removed the two chief obstacles to development of the Book Cliffs asphalt deposits. The need of highways has created a market of tremendous proportions. Transportation difficulties have been obviated by the construction of a 3½-mile rope tramway by the Utah Rock Asphalt Company. The open-pit mine of the company has been equipped with power machinery, and a mill, with a capacity of 1,400 tons daily, has been built at Sunnyside.

During the Tertiary age, pure silica sand was deposited by an inland sea. Subsequent pressure transformed this sand to sandstone. Later, asphaltic oil, highly volatilized and under enormous pressure, penetrated this sandstone to great depths and over wide areas, not only coating the sand but filling pores and voids. In Utah are deposits of asphaltic rock and sands where the quantity of bitumen is too high to permit the use of the mixture for road surfacing without the application of heat and inert material; but at Sunnyside the proportion of asphalt, ranging from 8 to 11 per cent, makes the product ideal for road building.

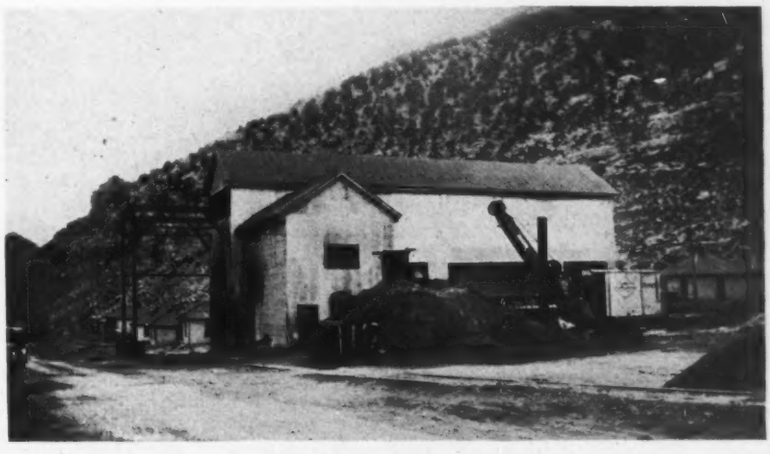
From summit to base, the stratum of rock asphalt measures 1,000 ft. Outcrops appear along the face of the Book Cliffs for 17 miles. So vast is the visible supply in this area that the engineer who tries to compute tonnage becomes lost in a maze of figures of astronomical magnitude. The principal holdings of the Utah Rock Asphalt Company, near Sunnyside, are estimated to contain 10,000,000,000 tons of rock asphalt, on the basis of 110 lb. to the cubic foot. About half of this amount, it is estimated, would pave all of the roads in the world, amounting to 6,582,000 miles, according to U. S. Department of Commerce statistics.

With the solution of the transportation problem, the outlook for the Carbon County rock asphalt industry takes on a changed aspect. Rock asphalt can now be conveyed from the mine to the terminal base in Whitemore Canyon at the rate of 720 tons daily, which capacity can be doubled when necessity requires. The rock is dumped into eight 5-ton loading pockets, and then loaded into trucks.

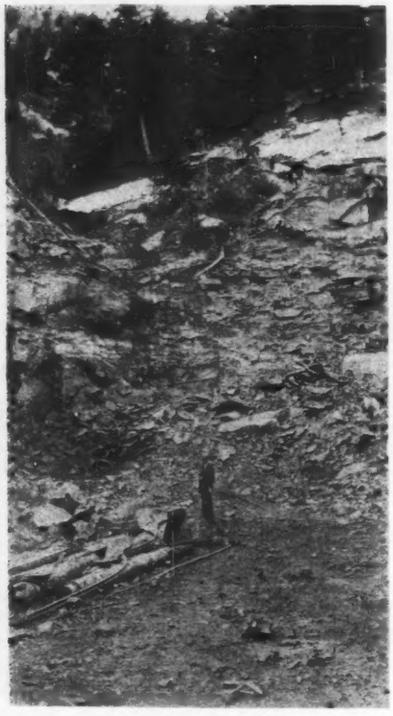
A fleet of four 5-ton Federal trucks hauls the material to the mill at Sunnyside, 2 miles distant. As soon as market conditions justify, the company plans to move its mill to the lower tramway terminal, and to build 2 miles of railroad from Sunnyside up the canyon. Rock will then be dumped directly into the mill from the tram buckets and the crushed rock asphalt loaded from the mill into railroad cars.

In mining the rock asphalt, benches, from 6 to 8 ft. wide, are cut in the side of the asphaltum cliff by drilling 12-ft. holes, 3 ft. from center to center, with No. 5 Ingersoll-Rand Jackhammers and 1-in. steel. The holes are loaded with 40 or 60 per cent dynamite, depending on the character of the rock. Several hundred tons of rock are blasted down at a time. Nearness of the face to the tramway terminal prevents heavier loading of the holes. Because of its "rubbery" quality, dynamite does not produce the shattering effect that is produced in limestone or shale. The overburden covering the asphaltum averages from 10 to 30 ft. In some places, high-grade material comes nearly to the surface.

Faces are sampled and numbered so that the asphalt rock may be maintained at the desired grade of 9 to 11



Mill of Utah Rock Asphalt



A 75-ft. face of rock asphalt at Sunnyside, Utah

per cent bitumen. Large pieces of rock are drilled and shot to reduce them for loading on the American Steel & Wire cars. A 60-hp. Osgood "Commander" heavy-duty gasoline shovel is used to load the overburden. A 10-ton Linn 75-hp. tractor, self-dumping type, hauls the overburden to the dump. Tram buckets have a capacity of 1,000 lb. each. The tramway was designed and erected by the American Steel & Wire Company.

At the mill, the rock is dumped into a 300-ton bin. Cast-iron bars, 1x6 in. x3 ft., placed at regular intervals, cover the belt conveyor. These bars are raised so that the material can feed on to the belt and the bin can be unloaded from front to back. A Jeffreys 36-in. belt conveyor carries the rock to a Jeffreys elevator. From the elevator, the rock asphalt is fed to an Allis-Chalmers 24x36-in. jaw crusher that breaks the feed to 6 in. or less in size. A Jeffreys elevator raises the rock to an Anaconda smooth-roll crusher (No. 2), which breaks the feed to 3 in. or less. The ore is then elevated to a Hum-mer screen, maximum ½ in., where the fine material is bypassed to the hydrator.

The feed is next put through an Anaconda corrugated crusher of the same size as No. 2. From No. 3 crusher, the asphalt is passed over two Hum-mer screens, maximum ½ in., that operate in tandem. Fines from the screen are fed directly to the hydrator, and the oversize is conveyed to a Williams hammer mill, in closed circuit with the Hum-mer screens in tandem. The hydrator consists of a 4x12-ft. steel cylinder, where a fine needle spray of water increases the moisture content to 4 per cent.

The mill feed is so gummy that it sticks to everything it touches, coating the machinery, floors, and woodwork. At the end of each eight-hour shift, crushing machinery and screens and conveyors must have a thorough cleaning.

Addition of water prevents the crushed material from reuniting into a compact mass during the journey by rail. The water coating given the asphalt adds but little weight and is a real benefit in the smoothing and rolling process on the roadbed. In shipment, only a comparatively thin film of cement asphalt forms on the top, the bottom and side covering effectively preventing any great loss of moisture during a long haul. By this method, shipments were made with success last year as far south as Santa Fé and as far east as Omaha and Chicago. In the latter city a mile of pavement was laid on a street that carries extremely heavy traffic.

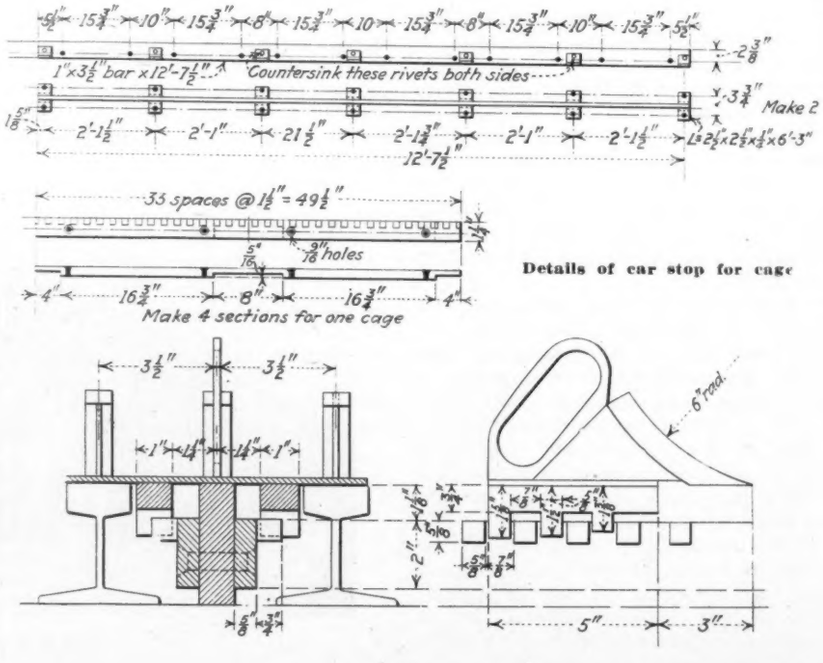
I wish to acknowledge indebtedness for the information contained in this article to Howard C. Means, former Utah state road engineer and now in charge of the activities in Utah and the Western states for the Utah Rock Asphalt Company; and also to William H. Haywood, superintendent of the mine and mill.

Ingenious Car-Stop Installation at Jerome, Ariz.

TO INSURE safe and continuous hoisting of ore when cars and cages are used instead of skips, reliable and light car stops are essential. Numerous accidents occur every year by the use of unsafe contrivances, such as wooden wedges or nuts, which fail to keep the loaded car secure within the cage.

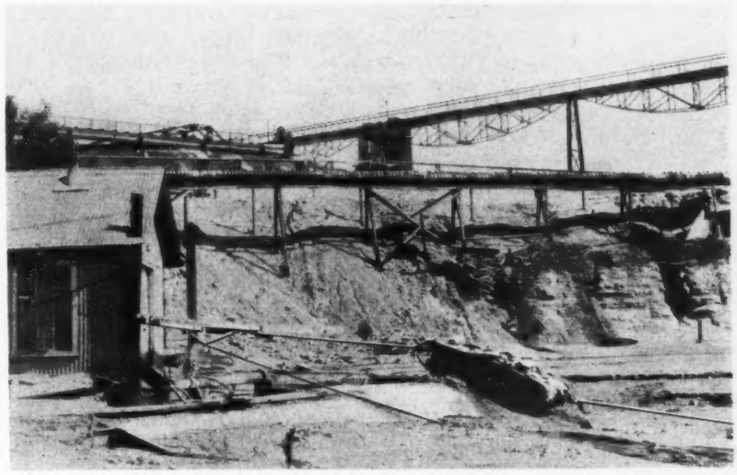
At United Verde Copper's mine at Jerome, Ariz., maximum safety is obtained with a recently developed car stop, shown in the accompanying illustration. The novel feature of the device is the application of square-toothed racks, with corresponding car-stop bottoms, to facilitate proper adjustment and anchoring of the car stops.

As shown in the illustration the entire installation consists of: (1) the cast-steel car stops, the bottom of which is equipped with square teeth varying in height and ⅛ in. smaller in width than those of the racks, and (2) two angle-iron rack supports, 12 ft. 7½ in. long. The supports, tightly secured to the cage floor, are so spaced between the cage rails as not to interfere with the car-wheel flanges. Hand holes facilitate the placing and removal of the car stops, which are immune to blows or side pressure, on account of the rack arrangement.



Details of car stop for cage

Liming Mill Water



Scraper removing sludge from pond to sump box

A. J. McDermid

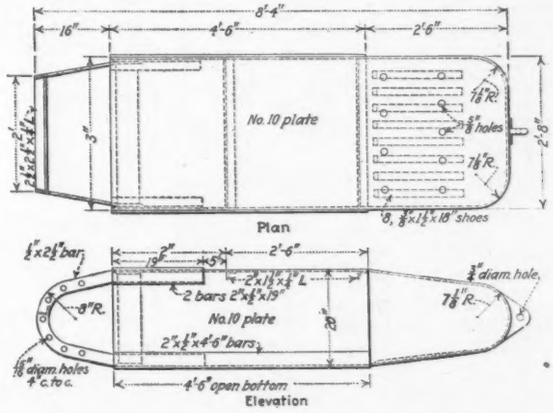
AT THE Miami Copper concentrator, Miami, Ariz., lime is added to the mill water in a novel way. Up to about three years ago lime was added in dry form to the ore stream in the coarse-crushing plant or in the concentrator. In passing through the mill pipe lines, lime scale and insoluble material from the lime rock settled out and built up on the insides of the pipes to such an extent that they had to be cleaned frequently or replaced. It was then decided to emulsify the lime first and then pump it into the mill pond, where the insoluble material would have a chance to settle out.

A lime plant, consisting of a jaw crusher, an 8-ft.x22-in. Hardinge mill, a Dorr agitating and storage tank, a Dorrco pump, and a feeder, was erected near the concentrator. Burnt lime is passed through these units in the order in which they are given and is then discharged as lime emulsion containing 16 per cent solids through a 1½-in. pipe line into a narrow channel through which the mill water enters the No. 1 mill pond. The current through this channel is comparatively swift and aids in diffusing the lime through the water. Insoluble material and the precipitated lime settle to the bottom of the pond and the clear water is pumped into the mill storage tanks. The lime plant is operated by one man on day shift only. Sixteen tons of lime rock is consumed daily. Of this 12 tons goes to the No. 1 mill pond and the remainder to the re-treatment section of the mill.

The Miami company buys most of its mill water from the Old Dominion mine at Globe. This water contains appreciable amounts of calcium and magnesium bicarbonates, which would cause decomposition of the xanthate which is used as a flotation reagent. Sufficient lime emulsion is added to precipitate the bicarbonate and to attain a phenolphthalein alkalinity of 0.25 to 0.35 lb. of free CaO per ton of water. That alkalinity is required to neutralize the acidity of the ore. The emulsion enters the pond at some distance from the pump intake, so that the water has approximately 24 hours' treatment before it is pumped to the mill. Return water from the tailings dump carries 0.04 lb. free CaO per ton.

The new method of adding lime has been satisfactory except that the insoluble material has filled up the mill pond to such an extent that some method of dredging had to be devised. After some experimenting a dragline scraper was built which successfully removes the sludge from the bottom of the pond. It was designed and constructed in the company shops and is shown in the accompanying drawing. It is made of No. 10 tank steel. The front end and the forward part of the bottom are open; the top is covered and perforated, as shown, with ⅜-in. holes, so that, as the scraper is filled with sludge, the water is forced out. The back end is rounded to reduce water resistance when the scraper is being pulled backward. In this scraper, the front bails are made of ½-in.x2½-in. mild-steel bars punched with six ¾-in. holes, so that the dragline can be adjusted to make the scraper cut deeper or shallower as desired. Although the scraper was made to operate in the position shown in the drawing—that is, with the top covered and the bottom open—at some depths of water better results are obtained when the machine is inverted so that the top is open and the bottom covered.

The scraper is pulled by a Sullivan HDE-2 double-drum 25-hp. electric hoist having a rope speed of 200 ft. per minute. Half-inch cables are used on both drums. An anchor cable is stretched across the pond on the side opposite the hoist. Its ends are fastened to deadmen on the shore of the pond, and intermediate points are clamped to two large rafts which hold it above the surface of the water. The 8-in. sheave block through which the tail rope passes can be clamped to any point on the anchor cable in the line with any part of the pond which needs to be cleaned out.



Sketch of Miami Copper's dragline scraper

When loaded the scraper is pulled up a steel-plate incline and over a sump box into which it dumps its load. In the photograph the scraper is shown being pulled up the incline. From the sump box, whose contents are kept stirred up by running in compressed air and water, the sludge is pumped into the main stream of mill tailing by a 6-in. Krogh dredge suction pump driven by a 75-hp. General Electric Motor. The scraper is at present operated for eight hours daily, but when the sediment which has been accumulating for three years has been removed, the operating time will be cut down considerably.

New Publications

TOWARDS CIVILIZATION. *By Charles A. Beard. New York: Longmans, Green & Company. Pp. 307. Price $3.*

"TOWARDS CIVILIZATION" is an answer to "Whither Mankind." Each deals with the modern civilization of the West—the mechanized civilization which to some seems so destructive of all "values, human and devine," that they pretend that they would willingly trade it for the days of the stage coach and spinning wheel or something equally uncomfortable. The distinguished contributors to "Whither Mankind," it seems left the impression that the engineer and technologist of the day, despite his great accomplishments, was not alive to the evil aspects of the machine age and was doing nothing to make life other than a mad whirl, with the pace faster and more nerve-racking. Whereupon the publishers, with Mr. Beard again as editor, drew together a representative group of scientists and engineers to review the accomplishments credited to them and their fellows as a class, with particular reference to their human aspects. The contributors, besides Mr. Beard, are: Robert A. Millikan, Lee de Forest, Michael Pupin, Lillian M. Gilbreth, Elmer A. Sperry, Richard F. Bach, Thomas D. Campbell, Harvey N. Davis, Ralph E. Flanders, C. F. Hirshfield, Dexter S. Kimball, Stephen F. Voorhees, Ralph T. Walker, L. W. Wallace, W. E. Wickenden, and Roy V. Wright.

Another reviewer — incidentally, he was one of the contributors to the earlier volume — has expressed the opinion that the engineers had made a poor job of answering the charge that the machine was the foe of all values that mankind cherishes. The criticism is unjust. True, they do not all talk directly to the point, presenting first the charge and then their answer to it, logically developed. But any editor knows that it is practically impossible to get sixteen individuals to talk to the point on the same question as if they were answering a questionnaire. Certainly these writers, each and all, make it clear that modern invention and engineering are steadily making life more livable for the portion of mankind fortunate enough to be within the radius of their influence. Disappearing, if not gone, are the days when only a fortunate few were able to enjoy a comfortable existence, to educate themselves and their children, to have beauty in the home, and time to devote to developing the soul. No longer is it possible in the United States that these advantages should belong to a few by mere accident of birth or fortune. Today, in this country, many a workman already lives more comfortably than did the noble of a few hundred years ago. This doubtless irks some critics of the modern day more than they would like to admit. Exclusiveness is nowhere near as exclusive as formerly.

Disagreeable aspects the machine age has, to be sure. Consider the congestion, noise, and bustle of the great centers of population, the dirt and drabness of the industrial town. But Rome was not built in a day, and the old cannot be remodeled into the new, even in a generation or two. Give the new era a chance. Indeed, one might exclaim here "Try to stop it!" The machine, instead of being the foe of all values, is merely a tool, an extension of man himself. It may have no soul, but with it man will be able to express his own soul to an extent impossible before its devising.

If prizes were to be awarded for the best of these essays, the reviewer would vote for Dean Kimball and his "Modern Industry and Management," for Bach and "Art in the Market Place," for Voorhis and Walker and their chapter on "The Machine and Architecture," and for Pupin, a European transplanted to the New World, who writes simply but strikingly on "Machine Industry and Idealism."

A. H. HUBBELL.

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METALLIFEROUS MINE SURVEYING. *By T. G. Hanton. London: Crosby Lockwood & Son. New York: Industrial Book Company. Pp. 236; illus. Price $4.50.*

THIS VOLUME thoroughly describes the subject matter indicated in its title. Although written by an Australian whose experience was gained in his native commonwealth, it also gives African, European, and American practices where conditions and usages require different handling of details.

The book is written to be easily read and understood, even though the treatment is technical. In addition to the chapters on instruments and their adjustments and use, underground and stope surveys, and connecting surface and underground surveys, it contains chapters on problems which the surveyor is often called upon to solve, such as those attending borehole surveys and the layout of railroad sidings.

This reviewer started reading the volume in a rather critical frame of mind, but had been converted to a fairly enthusiastic reader before finishing it; first, because it offered several new ideas (which are rare nowadays in books), and, second, because not a single typographical error or mistake was found in the formulas or problems presented (something also rare in present-day books).

WILLIAM R. CHEDSEY.

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CONSERVATION OF OUR NATURAL RESOURCES. *Edited by Loomis Havemeyer. New York: The Macmillan Company. Pp. 551. Price $5.50.*

BASED on Van Hise's "The Conservation of Natural Resources in the United States," issued twenty years ago, this volume brings together most of the recent available information on the extent and character of the country's reserves of minerals, its water supplies, its forests, wild life, and soil. The individual contributors, unlike most writers on the subject of natural resources, have no axe to grind. Instead of the usual alarmist statements, they are content to summarize such facts as are available, emphasizing their uncertain and changeable character.

G. A. Roush, editor of *Mineral Industry,* contributes the chapter on the mineral resources, the only one with which this review will concern itself. Mr. Roush is careful to warn his reader that estimates about the length of time that reserves of minerals will last are almost valueless. In this particular, he points out how improved technology has prevented waste in treatment ot minerals and how it has added large tonnages of formerly worthless material to potential reserves. What technology will do in the future is impossible to ascertain; and, without that knowledge, predictions as to the date when exhaustion of any given mineral will occur must be rank guesses.

Mr. Roush has included information concerning known mineral reserves, present technology, principal commercial uses, and possible improvements in treatment that might lead to greater efficiency, or, in the case of metals, to a more complete recovery for secondary use. He has not, however, pushed his study very far into the field of economics. For instance, he does point out that fluctuations in price mean that at times only high-grade ore will be extracted from a metal deposit and that the low-grade ore may be irretrievably lost, but he does not declare whether he believes steps should be taken to prevent fluctuating prices and thus to save the low-grade ore. Nor does he point out that improvements in technology have caused overproduction, which, in turn, has made mining companies search for new uses for their products. These new uses admittedly bring greater prosperity to the individual industry, increase

employment, and help to stabilize prices; but, if they are not essential uses, may not the loss to future generations be greater than our temporary gain? If more adequate control over production were afforded, either through private or governmental sources, might not these losses be avoided? To the believer in the free play of economic forces, in individualism, and unhindered competition, such control is abhorrent. But the conservationist is one who believes in systematic organization. Mr. Roush has made a valuable study from the factual standpoint, but to this reviewer it would have been even more valuable had he pursued his thought further afield, no matter what attitude he might have taken. As it stands now, one obtains the impression that the study is not complete. S. D. STRAUSS.

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GUIDE TO THE STUDY OF NON-METALLIC MINERAL PRODUCTS. *By W. S. Bayley. New York: Henry Holt & Company. Price $4.*

THE volume is designed as a textbook for a one-semester course in non-metallic mineral products, including jewels but excluding building stones. It covers the subjects in a general way and contains many footnote references to more specialized publications. The first section of the text is a general classification of non-metallic minerals into six major groups on the basis of their origin and geological occurrence. Assignment of the individual minerals to their respective groups is not clearly stated, though certain of them are selected as illustrative types. The classification is followed by a discussion of the origin, occurrence, uses, distribution, and output of the individual mineral products of commercial importance. The first group in the scheme of classification comprises mineral substances occurring as liquids or as mixtures of liquids and gases, and the first minerals described are water, petroleum, and natural gas. From this one would infer that the general plan of the text was to follow the scheme of classification, but there is a wide divergence from this scheme. The bitumens, oil shales, and coals are considered immediately after petroleum and gas, and before the discussion of salines (Group 2), though these organic solids find no logical place in either of the first two groups. Some of the later chapters revert to a classification by use. For example, there is a chapter on gems, one on abrasives, and one on ceramic materials, groups which comprise minerals that are quite diverse in origin and occurrence. It is a problem to determine the most logical order in which to treat non-metallic minerals, because they differ widely in nature and origin. Some are formed by several different processes, and some of them are used in many different ways. The method followed by Ladoo in his "Non-metallic Minerals," a method which has met with some criticism, was to treat the minerals in alphabetical order. For an economic textbook this method has distinct advantages. For a book designed as a basis for "study of the origin and occurrence of the more important non-metallic mineral substances," as stated in the first sentence of the preface, it would seem more logical and less likely to confuse the reader if the author had strictly followed in the text the order of classification by origin and occurrence. About 170 pages are devoted to the hydrocarbons such as petroleum gas and coal, and these subjects are handled very effectively. The inorganic non-metallics are introduced with a comprehensive review of the salines (such as salt, potash, borax) occupying 78 pages. Other important non-metallic mineral products of commerce—such as sand and gravel, limestone, lime, cement, magnesite, graphite, mica, barite, asbestos, talc, and soapstone—are covered much more briefly in succeeding chapters. The salient features essential to an elementary textbook are covered adequately, and in this age of rapid changes and developments data as late as 1927 are welcome. There is evidence of much careful and judicious selection of material. Though the mineral specialist will find little in the book that is not as readily available in other texts, the beginner in the study of non-metallic minerals will find in this volume a compilation of the more important facts essential to a general knowledge of the subject.

OLIVER BOWLES.

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THE MINERAL INDUSTRY, 1929, VOL. XXXVIII, *Edited by G. A. Roush. New York: McGraw-Hill Book Company. Pp. 845. Price $12.*

THIS reference book covers as far as is possible the development of the year in each individual field, including production and trade statistics, technical improvements, extension of plants, new source and uses, market conditions and prices, and other items of interest, both domestic and foreign, each subject as far as possible being placed in the hands of a specialist. The new volume is a little larger than last year's. Among the minor changes made the most important is the inclusion of two new section heads at the end of the volume, "Minor Metals" and "Minor Nonmetals," under which have been grouped several of the shorter sections formerly carried separately. Several new materials, not included in former volumes, which have become of sufficient commercial importance to warrant mention, have also been included.

The following new names may be found among the contributors: Percy E. Barbour, "Copper"; Carle R. Hayward, "The Metallurgy of Copper"; D. F. Walsh, "The Metallurgy of Lead"; Ivan A. Given, "Coal and Coke"; Samuel H. Dolbear, "Mica"; W. R. Rogers, joint author of the section on nickel.

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MECHANICAL ENGINEERS' HANDBOOK. *By L. S. Marks, assisted by 75 specialists. New York: McGraw-Hill Book Company. Pp. 2,264; illus. Price $7.*

Revision is essential to accuracy and comprehensiveness, and the second or subsequent edition of a work of reference is always more valuable than the first edition. Engineers will welcome the appearance of the third edition of a handbook that has found wide acceptance. Nearly 300 pages have been added, mainly to accommodate seven new sections, in which refractories, coal carbonization, and modern industrial furnaces and other subjects are discussed. Most of the book has been rewritten or revised to bring it up to date. The editor-in-chief, who is professor of mechanical engineering at Harvard University, shares with a distinguished group of contributors the credit for what will undoubtedly prove to be one of the most valuable reference books published in 1930.

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THE GEOLOGY OF THE GOGEBIC IRON RANGE. *By H. R. Aldrich. Bulletin 71. Wisconsin Geological Survey, Madison, Wis. Pp. 279. Numerous inserted maps.*

OF THE 80 miles of length of the Gogebic range, 53 lie within Wisconsin. Approximately eight townships are covered by the report, reaching from T.46-R.2E close to the Michigan line, to T.44-R.6W at the western end. The bulletin is the culmination of work first undertaken by the author in 1921. He credits earlier members of the staff with work done prior to that time. Part I deals with the history of the range and its production, with principles and practice or magnetic surveying, with the general geology, and, coming to particulars, with the structure of the Huronian series, with the origin of the Ironwood, and the development of ores. Part II gives maps and detailed descriptions of the townships. For each township the probabilities of finding ore are discussed. As to the probable life of the Gogebic range, the author sees no threat that it will be short. In its grade and production curves its vitality is shown to be strong. Underground evidences point to continuity, if not improvement. Wisconsin appears to be in best position for vigorous exploration in the next decade or two.

Comment and Criticism

Fracturing and Intrusives

To the Editor of "E.&M.J.":

To doubt that igneous agencies constitute the prime cause of epigenetic deposit formation is, in these magmatic days, like placing oneself in the position of the deacon of half a century ago who dared to doubt the literal accuracy of the Scriptures. To advance other causes that, though not superseding igneous action, tend only to modify or reduce its importance, may cause a backslider to be pitied, hated, or branded as an unbeliever. However, much observation concerning mineral districts indicates that, though igneous agencies are factors in the formation of ores, they may have received attention out of proportion to real value. Plutonism and the belief in igneous action have apparently with some become almost a creed, or at least a premise that has formed a basis for deductions that have discouraged observation, excepting in limited directions, and served to restrict the free collecting of facts that is the essence of inductive philosophy.

Early in my own field work, which included considerable prospecting, the impression was gained that, although igneous rocks ordinarily occurred in close proximity with ore deposits, they were of limited value as guides to finding ore. No good reason has been found to change this early view after many years' experience with orebodies. Undoubtedly, they have been useful in an academic sense, their study being valuable in supplying a basis for the action of solutions of deeper-seated origin; the relationship is usually observed, however, only after the ore has been found, and then is of such an indefinite nature as to be of little use in the task of finding mineral deposits elsewhere.

Holding this view, I have observed with interest the solicitude of engineers when the presence of intrusive rocks was not immediately obvious, or not abundant, or not in immediate proximity to the ore. It seemed not to matter that the ore had been found in quantity, nor proved to depth, nor that its character was open to inspection. Without the igneous rocks in proper quantity, quality, and propinquity, there was a defect, a desideratum that affected the deposits adversely. About the best description of the connection usually found between an ore deposit and its intrusives is that they are "associated." This word, lacking in the definiteness so essential to science, sinks in value to the disappearing point when considered from a utilitarian point of view.

Why not give attention to more useful studies, for economic geology is after all a utilitarian subject? The geology in which the mining engineer and the mine operator is primarily interested is economic geology, and "economic" is rarely synonymous with "scientific." Science may run afield, finding knowledge where it may. Its purview is unlimited. But when knowledge is restricted to the economic, it has a hard taskmaster, differentiating between the student and the performer. The task of economic geology is primarily the task of finding ore.

The study of fracturing and its relation to ore deposition may not at first sight offer encouragement to the student; but the subject may furnish surprises. It will not lend itself to overfree speculation. Being a subject that lies in the upper regions of the globe, theories will naturally lend themselves to proof or disproof, a deterrent against poorly founded speculations.

All students of the subject know that epigenetic deposits occur in regions of disturbance and fracturing. But fractures occur, especially along the flanks of mountain ranges, that, by their nature, must extend to great depths; but commonly they are entirely devoid of ore, as are most fractures, and here arises the necessity for their study; for what is the distinction between fractures that carry ore and those that do not? The answer is not igneous action, but with one of the oldest known phenomena connected with ore deposition. Some years ago I called attention to a remarkable geological condition prevailing at some of the most productive districts in Utah, the key to which proved to be the Uinta mountain disturbance—a fold beginning in the eastern part of Utah, and extending west for about 150 miles, until it abuts against the Wasatch range, lying north and south. Here the Uinta range loses its identity as the Uinta mountains, as its line of disturbance becomes indistinguishable in the more pronounced Wasatch break.

The Uinta disturbance does not end here, however. It passes on through the Wasatch range, crosses the lowlands to the west, dividing the latter into the Utah and Salt Lake valleys by a pronounced ridge at the point known as the "Narrows." Again it is lost as it enters the northerly and southerly Oquirrh mountains, but still it persists and reappears in the lowlands west of the Oquirrhs, where the division into two valleys occurs—the Rush and the Tooele. Then again it is lost as it enters the Stansbury range to the west, but the time not to reappear, or, if it does appear, its significance is inconsequential.

When the line of the Uinta disturbance is traced westwardly across the Wasatch and the Oquirrh ranges, its course is marked by a succession of mineral districts. Beginning with the eastern side of the Wasatch range are, first, Park City; and then, a few miles to the west, follows Alta, and its near neighbor, American Fork Canyon. Then leaving the Wasatch and crossing the valley to the Oquirrh range, 20 miles away, the famous Bingham Canyon appears. Further west is the Camp Floyd district, with its old mines at Mercur, and also the productive Ophir district. When one realizes that these mineralized sections occur within the narrow area followed by the Uinta break, and cease within a few miles to the north or south, that these districts have produced much more than all the rest of the mines scattered over the State of Utah, the fact becomes obvious that the results may fairly be attributed to the existence of a structural condition that, though it may be unique in magnitude, can hardly fail to find its prototype in many other regions.

These mineral districts have occurred where two lines of crustal weakness have met. In this no difficulty will be experienced in finding a well-understood although, relatively, a minor counterpart in the common intersection of fissures to form individual oreshoots. In the districts here considered, only a multiplication of the phenomena of the single intersection occurs. Mountain ranges ordinarily have several faults on one flank or both flanks, so several intersections will result when the two ranges meet. If the two lines of faulting intersect, a degree of crustal weakness must result that probably can be equaled by no other natural condition.

The foregoing demonstrates, principally, that cross-fracturing was the first essential step in the formation of the ore deposits. The Uinta and the Wasatch ranges extend far beyond any possible influence of the local intrusions in the several districts. The lines of disturbance represented by the mountain ranges were therefore independent of these intrusions. In the Uinta mountains, the range extends 150 miles east of the Park city district; the Wasatch and the Oquirrh ranges are of the ordinary north-and-south type common to the intermountain region.

Here the important point—and one likely to prove a feature of future theories concerning the deposition of ores—is that these fracturings occurred prior to the intrusions within the districts. That the Uinta disturbance should just "happen" to pass through this succession of unusual mineral districts is too improbable for consideration. More within reason is the conclusion that the weakness created by the intersections, especially where the flanks

of two ranges meet, explains why these groups of deposits are where they are.

The foregoing summary of the structural relations of the region under consideration shows the condition to be extraordinary in its magnitude and in the diversity and extent of its results. That these features exist is fully attested by the topographical sheets of the U. S. Geological Survey. Furthermore, that the structure herein described is peculiar alone to this section is highly improbable. In fact, such instances, on a smaller though still important scale, are common in the intermountain region of the United States. This subject I have already introduced (*Engineering and Mining Journal-Press,* Oct. 25, 1924), and there, among other examples, the Comstock Lode at Virginia City, Nev., was considered. The meeting of fracture zones is represented by the junction of the Washoe and the Flowry ranges (topographical sheets U.S.G.S.).

In the relegation of igneous activity to a second place in point of time, making it dependent for its manifestation upon a prior fracturing, I realize that a departure widely at variance with current beliefs is made. But in the examples considered are the facts; and this conclusion must be accepted or some other explanation must be found. The question arises as to why igneous agencies have so uniformly been prepared to ascend through these favorable openings and make their way toward the surface. Is it that the whole crust is underlain with highly heated rock material—a universal magma? Or was the action accompanying fracturing itself a promoter of igneous activity? Is the answer to be found in one of these conditions, or is the pronounced volcanism observed in connection with ore deposits a combined result of the two?

The condition here discussed may be replete with possibilities. The study of structure and its relation to the localization of the ore deposits is of value to the ore hunter. In the deposits considered in Utah, a comprehensive study of the Uinta and Wasatch faulting would probably throw light on the ore occurrences in those sections and prove of value in the further discovery of orebodies. Also, crustal disturbances on a tectonic scale, which give rise to extensive cross faulting that must extend to profound depth and produce an extreme crustal instability, should contain lessons for the scientist in his pursuit of pure knowledge. Here should be found problems of special interest to the physicist from the point of view of the development of heat. I have already advanced some ideas on this point. (*Trans.* A.I.M.E., Separate No. 1512, December, 1925). The production of heat, under such conditions as have been here considered, seems inevitable from our established knowledge on the subjects of friction and heat.

CHARLES A. PORTER.

Philadelphia.

Licensing of Engineers

To the Editor of "E.&M.J.":

I am glad to see by the Aug. 23 issue of *Engineering and Mining Journal* that you are attempting to stimulate mining engineers into taking an active part in improving the license laws in states where none now exist.

Speaking from my own experience in New York State, where I have served as secretary of the New York Section of the American Society of Civil Engineers for the past three years, the indifference or open opposition to license laws on the part of mining engineers has been one of the serious obstacles in the way of getting much-needed legislation passed. Only last spring the New York Section of the Institute had a meeting to discuss what disposition should be made of a fund of about $1,000 turned over to it, as I understand, by the parent society, for the purpose of *fighting* licensing.

Many engineers in states where license laws are already on the statute books fail to realize that the day for fighting licensing is past; that whether they like licensing or not is now an academic question. The practical question is one of perfecting the laws we have, and seeing that they are not tampered with for the benefit of a few individuals.

To be specific: Mining engineers have always opposed a citizenship requirement in license laws because of the possibility of reciprocal legislation in foreign countries; yet here in New York State, because their policy is that of fighting license laws, they left the whole brunt of the defense of the existing laws upon the civil engineers, when an attempt was made to modify the law to include, among other things, a citizenship requirement.

The license laws in most states are imperfect and need careful consideration in the preparation of amending legislation. The support of the mining engineering profession is needed in that work. There can be no neutral ground, and the old saying holds here as well as elsewhere, that "those who are not for us are against us." When it comes to talking to legislative committees, if the mining engineers are not represented as favoring the legislation, they are assumed by the legislators to be opposed to it.

V. T. BOUGHTON.

New York.

To the Editor of "E.&M.J.":

A copy of your editorial in the Aug. 23 issue of the *Engineering and Mining Journal* entitled "Status of Engineer Licensing Unchanged Despite Opposition" has come to my attention. I wish all of the mining engineers in this country could be converted to that attitude. My interest in registration in California was aroused primarily for the reason which you state in this editorial, and that was that registration was inevitable, and as long as California kept away from enacting it the greater would become the danger of confronting men who could not meet the requirements set up in other states, and the sooner we made a start in California the sooner we would pass the educational period and be able to place registration on an effective basis. It was for this reason, when opposition developed among the mining and electrical engineers, that we limited registration to civil engineers, feeling that that would give us a board and give civil engineering a legal standing.

We are trying to administer the act in as intelligent a manner as possible, not setting ourselves up as a group of autocrats, and I think we are getting very favorable reaction as a result.

I have always felt that the attitude of the mining engineers was typical of the attitude of the engineering profession in general on a lot of questions: individualistic to the extreme. Such an attitude has been behind a lot of the situations which cause engineers to crab about their profession whenever they get together, and it is not alone found among the mining engineers but among all of the other branches of the profession.

DONALD M. BAKER,
President, Board of Registration
for Civil Engineers, State
of California.

Los Angeles.

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Gold Ore at Depth

To the Editor of "E.&M.J.":

In regard to the editorial in the Aug. 9 issue of *Engineering and Mining Journal,* as to pay ore at depth, the following is of interest:

The three deep mines in Amador County, Calif., find excellent ore on the lower levels. For instance, the Argonaut mine, at a depth of 5,600 ft. (incline), has struck rich ore; vertical measurement, nearly 5,000 ft. This ore was found after going through several hundred feet of rock that did not pay. The Central Eureka mine has had similar experience. From the 700 to the 1,200 level the ore was rich, but it did not pay from the 1,700 to the 3,100 level. Excellent ore was found from the 3,400 to the 4,800 level, incline measurement. The Old Eureka mine also is finding good ore below the area the former owners considered barren. Thus it appears that with depth on the Mother Lode, especially in Amador County, excellent ore is found.

G. CHESTER BROWN

San Francisco.

Personal Notes

C. L. Kingman has been appointed permanent secretary of the New York Mining Exchange.

Walter H. Weed has returned from the Bor copper mine, in Yugoslavia, and other mining camps of that country.

Sir **Douglas Mawson** plans to return to the Antarctic in November to complete his geological investigations of the region.

J. T. Milliken, mining engineer, of Colorado Springs, Colo., is developing a fluorspar property near Salida, Chaffee County, Colo.

Sidney Rolle, of the Carteret (N. J.) plant of U. S. Metals Refining, sailed for Europe on the "Europa" on Oct. 3. He expects to be gone for about a month.

Dr. **W. R. Jillson,** State Geologist of Kentucky, has been proposed as Republican candidate for Lieutenant Governor of his state, in the forthcoming election.

G. H. Garrey, who recently completed an examination in Nevada, is making geological surface and underground maps of the mines in the Summitville district, Rio Grande County, Colo.

Stephen L. Brown and **Edward K. Pryor** have been appointed U. S. Bureau of Mines fellows at the University of Arizona for the school year 1930-31. Both will make metallurgical studies.

Philip Carpenter, of London, a student at the Royal School of Mines, is spending a year in the United States on a fellowship, for the purpose of studying mining and ore-treatment methods in several mining districts.

W. H. Newhouse, associate professor of economic geology at the Massachusetts Institute of Technology, spent the summer at Western mining camps, investigating structural relations of oreshoots, under a grant received from the Institute for this purpose.

J. W. Feiss, geologist, recently on the staff of Rhodesian Congo Border Concession, has returned to the United States, and is now associated with the mining engineering department of Crowell & Murray, Inc., with headquarters at Cleveland, Ohio.

Robert F. Wood, of Newark, N. J., draws attention to the fact that the table of conversion factors in the issue of Aug. 9, 1930, p. 131, contains an error. The fifth figure down in the last column should be 0.0_64732, not 0.0_44732, as stated. Readers who are using this chart are asked to make the necessary correction thereon.

Waldemar Lindgren is chairman of a committee selected by the representatives of the principal geological groups in the United States to organize the next meeting of the International Geological Congress, which will be held in the United States in 1932. The preparation and publication of a monograph on the petroleum resources of the world is planned as the major outcome of this meeting.

OBITUARY

D. B. Gaffney, geologist, who practiced his profession in Colorado for 40 years, died recently in New York. He was 75 years of age.

Dr. **W. D. Matthew,** noted paleontologist, died recently in San Francisco after a four months' illness. He was for many years the curator of paleontology, geology, and minerals at the American Museum of Natural History in New York.

DANIEL GUGGENHEIM

Daniel Guggenheim, a member of the firm of Guggenheim Brothers, died suddenly of heart disease, on Sept. 28, at his summer home near Port Washington, Long Island, N. Y. He was actively connected with the many mining and metallurgical enterprises founded and operated by the Guggenheim interests, although for the last few years he had been considerably less active in business. Daniel Guggenheim was particularly interested in the diamond-mining activities of his firm, and was decorated by King Leopold of Belgium for his services in the development of diamond-mining properties in the Belgian Congo. For a period of about twenty years he was either president or chairman of the board of directors of American Smelting & Refining. He was widely known for his philanthropies, and for his great interest in the science of aviation. Mr. Guggenheim was 74 years of age, and is survived by his widow, two sons, and one daughter.

Samuel Newhouse, pioneer Colorado and Utah mining man, died on Sept. 22, at his home near Paris, France. He was born in New York in 1854. Mr. Newhouse abandoned his career as a law student in Scranton, Pa., to go to Leadville, Colo., in 1879, as a journalist. Leaving this profession he started work as a miner, thus gaining valuable experience in actual mine operation. His activities had a marked effect on the development of mining in Utah. His first Utah interest was the Highland Boy mine, and later he operated and then also sold the Boston Consolidated, another Bingham Canyon property. He started the Newhouse tunnel project at Idaho Springs, Colo., and developed several properties in Colorado and Idaho.

Samuel M. Soupcoff died at Douglaston, Long Island, N. Y., on Sept. 20. For several years he had been associated with the Utah department of American Smelting & Refining. On Aug. 1 of this year he resigned to take a position in the mining securities department of a brokerage house in New York City. Mr. Soupcoff was born in Russia 44 years ago. While he was still a child, his parents emigrated with him to Brooklyn, N. Y. He attended the Colorado School of Mines, and after his graduation in 1910 he entered the employ of Anaconda Copper Mining. Later he was associated with John B. Farish, consulting engineer, and examined mines in Canada, Alaska, and Mexico. In 1913 he was employed by the Guggenheim interests, and in 1916 by American Smelting & Refining. For the last twelve years he had been a resident of Salt Lake City.

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An Appreciation

Edward G. Kane, assistant general superintendent of mines for Anaconda Copper Mining, at Butte, Mont., died in Butte on Sept. 12, 1930, after an illness of three months. He was the son of John P. Kane, formerly a superintendent of mines for the Anaconda company. He was born in Butte, Oct. 27, 1888, attended the local grade and high schools, and graduated from the Montana State School of Mines in 1909. While attending the School of Mines he was prominent in athletics and other college activities, and after graduation became very helpful to later graduates and the school, being at the time of his death the president of the alumni association. After his graduation in 1909 he entered the engineering department of the Anaconda company, and later was transferred to the operating department, in which he filled the positions of shift boss, assistant foreman, and foreman up to 1926 at the Bell-Diamond mine, when he became assistant general superintendent of mines. During one administration he was City Engineer of Butte.

In 1921 Mr. Kane married Isabelle McCarthy, of Butte, who, with two children, is now living in that city. Throughout his career he maintained and strengthened a fine reputation by his honesty, fairness, industry, and loyalty. His continuous advancement was evidence of his intelligence and efficiency, and, when considered with the fact that he ranked high in the esteem of the men around the mines, the executive staff of the company and his other associates, the conclusion is that his work was well done, and that his duties in life were carried on with a high degree of merit and satisfaction. He had completed more than twenty years of fine service with Anaconda, and his passing will be a positive loss to the operating department of the company and his many friends and associates.

Anaconda, Mont. C. L. BERRIEN.

INDUSTRIAL PROGRESS

Steel Displaces Timber Underground

Long-Term Trial of Effective Connecting Members Demonstrates Their Efficiency

Fig. 1—Background shows drift, sheathed in masonry, July, 1927. Originally circular, it is egg-shaped, because of lateral pressure. Flexible beam structure in foreground erected August, 1927, adjacent to masonry. Play of shoe, 40 cm. (15¾ in.) in all, has been taken up only to the extent of 20 cm. (7¾ in.). Structures, particularly the upright, are undamaged, whereas rigidly connected neighboring beams have had to be replaced in part.

EXPERIENCE with and research on the movement of rock masses underground draw attention to the expansive power of compressed ore at great depths, whenever an excavation offers the opportunity for release of these forces. No shaft can withstand this expansive force, but, after the force has been released, a state of rest sets in and the load on the workings recedes to but a fraction of its previous amount.

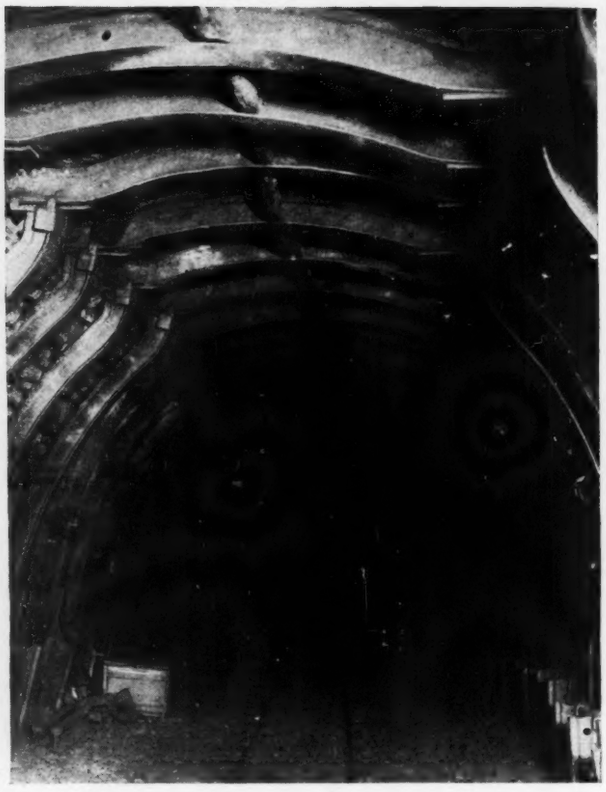
Movements of the ground, as a result of mining operations, scarcely tax the mine if the various units all take part in the motion. Flexible construction is therefore desirable. For this purpose pointed wooden posts and, to an increasing extent, iron posts have been introduced, the advantage of which lies largely in their flexibility and ability to develop increasing resistance to ground movement. Most new methods of ground support, such as those of Schäfer or Neubauer, make use of the flexibility to be obtained by using individual rings and beams of wood. Even in the so-called rigid methods, such as those of Walter and Henkel, the movability of the various sections is an important characteristic.

Concrete construction, because of its high cost, is applicable only to especially important and long-service passageways. On the other hand, wooden construction is not sufficiently resistant to the acting forces or to the action of weather, because of rotting. Hence the means employed hitherto have been inadequate. The otherwise satisfactory iron construction, especially that employing old rails, had no continuing flexibility, so that any pressure led to deformation. This in turn led to undesirable narrowing of the passages. To meet this difficulty, two iron connecting shoes for iron trusswork have been developed and are being made by the Queens Söhne company, Gladbeck, Germany, one of which serves as cap shoe, the other as a stilt at the bottom of the upright. These are shown in accompanying photographs.

The cap shoe consists of the iron shoe proper, an inserted flat wedge, and a small plate spring. When used as a connection between the upright and the horizontal beam it rests on the top of the wooden or iron upright, fastened to the horizontal iron rail with the aid of wedge and spring. Horizontal pressure forces the legs in the direction of the passage. The shoe is pushed against

Fig. 2—Installation of curved-beam construction on lower level of same mine, where particularly powerful forces are active. Previous structure consisted of horizontal rails and wooden uprights, about 60 cm. (23⅝ in.) apart. Wooden members were almost all broken and splintered; horizontals were kept in place by emergency measures, as visible far in the distance. Installation of new type begun November, 1929, and has yet shown scarcely any change. A slight shift in the stilt shoes is noticeable in case of those placed in service first.

Compiled from various sources, private and published, including *Glückauf*.



Left, Fig. 3—Well-preserved iron structure of straight rails. Play of cap shoe more or less taken up throughout, as evidenced from protruding wedge plate under the horizontals in the picture. Uprights show slight inward bent, as result of pressure. This indicates that spring in shoe has been correctly chosen from standpoint of resistance, allowing timely recession of shoe. Otherwise, construction is unchanged since installation in August, 1928. Right, Fig. 4—Curved rail structure visible in background of Fig. 2 and installed September, 1928. Lateral forces have caused play in shoe to be taken up. Movement of up to 15 cm. also visible in stilt shoes. Damaged construction in distance consists of iron horizontals and wooden uprights, installed October, 1928

the wedge, which, in turn, presses the spring. Resistance against the pressure of the ground is therefore dependent on the inclination of the wedge and the strength of the spring.

The stilt shoe works on the same principle, although the shoe is built for the insertion of the upright rail. Inasmuch as it is generally exposed to greater pressure than is the cap shoe, it is usually of sturdier construction; the springs, too, are 3.4 to 4.5 mm. (0.134 to 0.18 in.) in thickness, compared to 2 or 3 mm. (0.078 to 0.118 in.) in the former case.

In the practice described, the springs are U-shaped metal leaves. The wedge has a strong taper at its extremity, then becomes flatter, although always retaining its slope, and finally ends in a sharp widening. The resistance offered by it increases rapidly at first, but only slowly as the wider portion becomes active. When used to the end, the widened portion comes into play and prevents further motion. A sudden defection, as happens in the case of some other designs, is therefore prevented. Construction of the wedge tends to offer an increasing resistance at first, but finally a constant one. The wedge should be so designed that the resistance offered just compensates for the decrease in resistance.

The Queens shoes are being tested in the Möller shaft at Gladbeck, in which they are being experimentally used, and at the Technical School at Breslau, where the labortory is subjecting them to pressure.

In the Möller mines the cap shoes were used in passages on the third and second level. In the first installation they served since 1927 as connections between a wooden upright and an iron horizontal. Adjacent to this testing area, a passage was lined with concrete blocks which has now been compressed elliptically—evidence of the high pressure. The posts with shoes were eventually pushed forward slightly, but the device had been called into service only to a fractional extent. The neighboring posts, with rigid connections, displayed numerous fractures, and many have already been replaced.

On the second level, a complete iron structure had been installed with cap and stilt shoes. The trial was made at a point where the ground was in particularly active motion. As a result, the flexibility of the connection was put to test even 1½ months after installation. The stilt shoe had receded 5 cm. (1.97 in.), the cap shoe about 20 cm. (7.88 in.). The cross-section of the passage was therefore slightly narrower, but the original form was retained. Uprights and horizontals were not distorted, and the whole appearance gives no evidence of the forces present.

Laboratory pressure tests met with difficulties because the pressure from the top, artificially maintained, acted eccentrically and distorted the claws of the shoe and interfered with the test. The manufacturer, therefore, recommended the stilt shoe, built for strain in the direction of the wedge, with

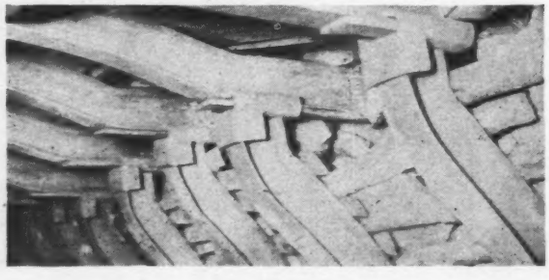


Fig. 5—Example of a cap-shoe connection tasked almost to limit by local pressure

claws which could withstand the eccentric pressure in the trial press. This substitution proved fully justified; the stilt shoe successfully withstood all tests. However, a similar strength is unnecessary for the cap shoe, because it is fastened differently, and hence not subject to the eccentric pressure appearing in the testing apparatus. Inspection of the posts in the Möller mines has also shown that the construction of the cap shoe is sufficiently strong to make a more expensive unit superfluous.

Evidence was forthcoming from the trials that the shoes offer a rapidly increasing resistance at first, then a constant one. Although the conditions of tests do not allow measurement when the entire length of wedge was called into play and protuberance occurs, the results nevertheless give a clear picture of the action of the shoes. They have shown that these devices possess the desired flexibility on increase of resistance to a constant maximum. They therefore meet a structural inadequacy that has hitherto existed and should further the application of old rails in the many instances where applicable.

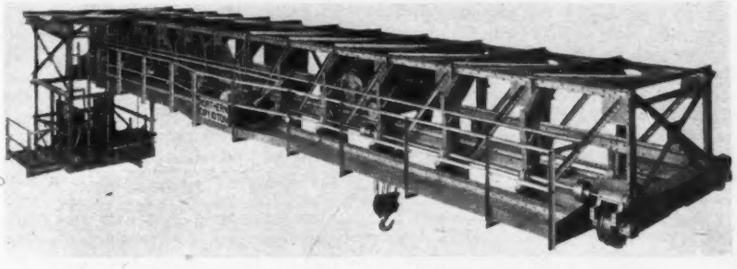
Results in the Möller mine at Gladbeck since the installation of the cap and stilt shoes referred to (so-called Diplomat) have been recorded by photographs, which are reproduced herewith. Use of both types insures flexibility toward pressure from any direction. The stilt shoe, in addition, makes the uprights adjustable in length. Use of curved beam surface gives a greater resistance to the extreme pressure that sometimes occurs.

The conclusion to be drawn from these pictures and experiences is that the flexible shoe type of construction, combined with iron beams, has justified itself in service. It guarantees a many times longer service than the usual rigid type of construction and offers, because of its flexibility, a dependable insurance against sudden ruptures, with their hazards, interruptions, and loss.

New Aluminum Crane Represents Saving in Weight of 47,100 Lb.

SIX unusual overhead traveling cranes have recently been built by the Northern Engineering Works, Detroit, Mich., for the United States Aluminum Company, Pittsburgh, Pa., for the latter company's new sheet-rolling mills at Alcoa, Tenn. One is shown in the accompanying illustration. These cranes are especially interesting from several viewpoints. But the design and the construction of the bridge are unusual, and the crane, including the trolley, is made almost entirely from aluminum-alloy, rolled, structural sections and aluminum-alloy castings.

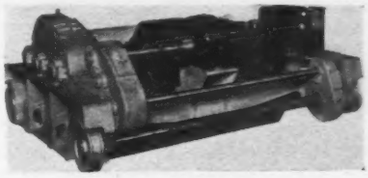
The crane illustrated has a capacity of 10 tons. The span of the bridge is 76 ft. 6 in. between truck wheels. Height of lift on the hoisting hook is 25 ft. Three mill-type motors, for 220 volts direct current, drive respectively the hoist, bridge travel, and trolley travel. They are provided with full magnetic control, placed in the operator's cab, which is at one end of the bridge. The hoist operates at a full-load speed of 50 ft. per minute, and is provided with a 19-hp. motor. When fully loaded the bridge travels at a speed of 400 ft. per minute, and is also provided with a 19-hp. motor. The trolley travels at a speed of 150 ft. per minute, driven by a 4¼-hp. motor.



Overhead 10-ton crane built almost entirely of aluminum alloy

In designing the crane bridge the latticed girder type of construction has been used. The bridge is the first of this type to be designed and built for crane purposes, made entirely from aluminum-alloy rolled structural sections. Its design not only accomplishes a saving in head room, which was a factor in this installation, but materially reduces the weight of the structure under what it would have been with the conventional steel-plate girder design. The bridge structure is made up of rolled aluminum structural sections, No. 17 S T alloy, consisting of channels, angles, plates, rails, rivets, and bolts and nuts. All rivets used in the structure are aluminum; also the T rail on which the crane trolley runs, including the hook bolts and nuts that secure it to the girders. All bolts and nuts and electric conduit and fittings are also of aluminum. The footwalk, which runs the full length of the bridge, is made entirely of aluminum, including the checkered floor plates.

The trucks which carry the bridge are aluminum castings, made of 195 alloy. All gear housings, gear covers, bearing housings, transmission cases and covers, and line-shaft bearings were made from aluminum alloy. The main line or driving shaft extending the full length of the bridge, which drives both end trucks, was made from aluminum and has a hollow center. This shaft is carried in self-aligning bearing journals, spaced at regular intervals along the bridge girder. The bridge is provided throughout with Hyatt roller bearings and Alemite forced lubrication. Aside from the saving in weight due to the nature of the material employed, every part and member entering into the construction of the finished crane was designed for minimum weight and at the same time for maximum effectiveness at the point where it was intended to function. The trolley used is a standard type (NE) made by the Northern company.



Hoist of new aluminum crane

The weight of the structural parts of the bridge alone in aluminum, including the latticed type girders, is 16,300 lb. If made of steel, the same structural parts, with the conventional plate type box girder, would have weighed 46,600 lb. The weight of the bridge complete without the trolley is 24,500 lb. In steel it would have been 68,800 lb. The weight of the trolley unit alone is 5,500 lb. In steel it would have been 8,300 lb. Total net weight of the entire crane, including the trolley, is 30,000 lb. In steel it would have been 77,100 lb., representing a total saving of 47,100 lb. in the weight of the complete, finished crane.

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Worthington Acquires Gilman

Announcement has been made by the Worthington Pump & Machinery Corporation that it has acquired the Gilman line of rock drills, heat-treating machines, furnaces, and accessories. Thus in combination with Worthington compressors, pumps, and engines, the company has a completely rounded-out line of machinery for mine, quarry, and industrial use.

NEWS OF THE INDUSTRY

A. S. & R. Relinquishes Yak Tunnel Rights

American Smelting & Refining has relinquished all its rights in the Yak tunnel, at Leadville, Colo., by returning to Yak Mining, Milling & Tunnel—the original owner of the property—the half interest that it has held for the last twelve years. The Yak company is now negotiating leases with local mine operators for the purpose of resuming operations.

The Yak tunnel, at Leadville, is a 4-mile transportation and drainage tunnel. In addition to the tunnel, the Yak company owns 250 acres and controls an additional area of 1,133 acres at Leadville. The ore developed by the tunnel is a complex sulphide, containing gold, silver, lead, and zinc. Production within the last few years has dropped off markedly, due to lower prices for metals. Most of the ore that has been produced has been treated in the Leadville Zinc-Lead flotation plant, formerly owned by Colorado Zinc-Lead, and the lead concentrate has been smelted at the Arkansas Valley smelter of A. S. & R. Relinquishing of its interest in Yak does not affect the smelting company's holdings in Leadville Deep Mines, still the largest producer in the district.

According to the agreement by which American Smelting & Refining acquired control in 1918, an undivided half interest in the Yak property was sold to it for $500,000. Although not a lien on the property, this sum was to be returned to A. S. & R. out of the profits of operations, after which both companies were to share profits equally. Since 1924, most of the production from the property has come from leasing operations, although some ore has been produced on company account from the Cord, Ruby, and Habendum claims.

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New Lake Shore Mill Unit Put Into Operation

Lake Shore Mines has started some of the equipment added to its mill, at Kirkland Lake, Ont., to bring capacity up to 2,000 tons daily, and is now probably producing at a higher rate than any other gold mine in the American continents, a distinction formerly held by Hollinger Consolidated. Production for the fiscal year ended June 30 was $6,576,780, according to the annual report just issued, from the treatment of 467,648 tons of ore, or an average of about 1,300 tons daily.

Development work on the No. 2 vein system on the 1,800, 2,000, and 2,200 levels of the mine has shown very satisfactory results, according to E. B. Knapp, superintendent of the mine. No. 3 shaft, which is now down to 2,400 ft., will be continued to 2,600 ft. The old shaft has been virtually completed to 2,200 ft. One interesting feature of the report was the reduction in total costs from $7.15 a ton to $6.94. Handling the larger tonnage for which Lake Shore is now equipped, further decreases are anticipated.

Furness Analyses Soviet Program for Production of Metals and Ores

EXPORTATION of relatively large tonnages of mineral raw materials from Russia is indicated if the so-called Five-Year Plan of the U.S.S.R. for development and expansion of mineral production is successfully realized. Exportation will be necessary both to finance industry and to absorb excess production, as domestic Russian consumption will hardly be sufficient if the expectations of the Soviet government are realized. The program calls for an increase of almost 100 per cent in basic mineral raw materials above production before the World War, according to Dr. J. W. Furness, chief of the minerals division of the U. S. Department of Commerce.

The vast unexplored territory of Russia makes any appraisal of its future in mineral production highly problematical, Dr. Furness said. During the last five years, however, an intensive campaign under the direction of D. J. Mushketov, director of the Russian Geological Survey, to evaluate the mineral resources has made available definite data upon which to base an estimate. The following information as to Russian resources, production, and trade in important metals and metallic ores was furnished by Dr. Furness:

Soviet Russia's asbestos resources are probably as large as or larger than those of either Canada or South Africa, now the leading producers. The principal occurrences are in the Bazhenovo district, Ekaterinburg. Reserves have been estimated by a Russian authority at 8,500,000 metric tons. The quality of Russian asbestos is poorer than the Canadian or South African product, but price differences neutralize this disadvantage. Production for the year 1927-1928 was 26,417 metric tons, compared with the 1913 output of 23,000 metric tons, which was the highest before the War. Exports in 1913 were 12,389 metric tons and in 1927-1928 they totaled 11,164 metric tons.

That Russia is endeavoring to participate in the American market would seem to be indicated by the recent shipment of 1,200 tons of relatively high-grade crude asbestos to this country. The price that is being asked for it is not known. The values of Russian asbestos exports in 1927-28 and 1928-29 were $1,651,351 and $2,360,470, respectively, indicating an average value of $148 and $183 respectively. Germany takes about 90 per cent of the exports.

Chromite was not specifically mentioned in the Five-Year Plan. For many years Russia has produced this ore, shipping most of the output to other countries. Before 1913, production varied between 20,000 and 26,000 metric tons per year, or about 20 per cent of world production at that time. Since 1924, production has been about 30,000 tons, or 6.6 per cent of present world production. Reserves have been materially increased by new discoveries during the last five years, and production is expected to increase materially. Most of the production comes from the Urals; the rest being mined in the Bashkirian republic.

Little authentic information on copper reserves of Russia is available. About half of the production has come from Siberia in the past, 35 per cent from the Urals, 10 per cent from the Caucasus, and 5 per cent elsewhere. Prior to the World War, production was increasing and imports were diminishing. In 1910, output was 22,225 metric tons, and in 1913 and 1914 it averaged 32,260 metric tons. Imports were 7,700 tons in 1911; 6,940, in 1912; and 6,030, in 1913. Domestic per-capita consumption in Russia is small, therefore. Output in 1927-28 was 28,300 tons, and by 1932-33 the Five-Year Plan calls for 85,000 tons. The exportable surplus, if any, will have relatively little influence on world copper markets.

Gold has been produced in Russia for centuries. In 1913 output was 1,956,485 oz. troy. For the year 1926-27, it was 736,607 oz. troy. A Russian authority in an article appearing in *La Vie Economique des Soviets* (July 15, 1930) states that, "The gold deposits worked for many years, even hundreds of years in some cases, as those at Beresov, are far from being exhausted by the primitive methods used. . . . The U.S.S.R. may, therefore, be assured of a sufficient supply of the valuable yellow metal for its national economy for many years."

Iron ore is found in many localities in Russia. The Ukraine and the Urals have been the chief producing centers, and reserves there are sufficiently large to justify the proposed rate of exploitation set forth in the Five-Year Plan. Prior to 1913, the annual output averaged 4,000,000 metric tons for five years. During 1928-29, about 4,000,000 tons of steel was produced, which, translated into ore, would mean about 9,000,000 metric tons in that fiscal year. By 1932-1933, output will be 17,000,000 tons of metal, according to the program. Large plants will be constructed at Magnitogorsk and Kusnetz, in addition to modernization of the present southern units. Because of the industrial expansion planned, any surplus for exportation will probably be small.

Russia is one of the four major sources of manganese. At present the partially developed reserves of high-grade ore are estimated at from 75,000,000 to 150,000,000 tons. Nearly the entire output is obtained from the Tchiaturi deposits, in Georgia, and Nikopol, in the Ukraine. Tchiaturi is by far the larger. The geological occurrence of these deposits, as well as their geographic position, has enabled Russia to maintain its position as one of the lowest-cost producers in the world. Production from Tchiaturi started in 1879 and, broadly speaking, it has ever since been the dominating factor in establishing the world price. In 1913, world output of manganese ore was about 2,400,000 long tons, of which Russia produced 1,289,730 tons and India, 815,047. In 1927, world production

The Westinghouse memorial in Schenley Park, Pittsburgh

was about 3,200,000 tons, of which Russia contributed 1,109,389 tons and India, 1,129,353 tons.

For a period during and after the World War, Russian manganese production was at a low ebb. A concession including the Tchiaturi deposits was granted to an American company, which operated for about two years. The government then claimed that, as an emergency measure, it was forced to undertake exploitation of the mines because the concessionaires had not carried out the program of important improvements provided for in the agreement. The government also claimed that the ending of the concession was necessary to prevent the endangering of the revenues it derives from the local industry by the increasing production of other countries. In spite of the proposed expansion of the Soviet steel industry as called for in the Five-Year Plan, Russia will probably continue to have a large exportable surplus of manganese for many years.

Russia has also long been the largest producer of platinum. In 1913, world production was 268,333 oz., of which Russia contributed 250,000 oz. In 1927, world production was 149,275 oz., of which Russia contributed 100,000 oz. The price of platinum has fluctuated widely, because of the absence of Russian platinum from the world market after the World War, but it is now only about $34 an ounce as a result of the increase in production from South Africa, Canada, and Colombia. With present world consumption about 170,000 oz. a year, overproduction seems likely for the next few years. As Russia is one of the low-cost producers, the position it occupies will probably be that of the dominating factor in determining the price.

Known bauxite deposits in Russia are relatively small in tonnage compared with those in other deposits throughout the world. The largest deposit, the Tikhvin, contains about 2,000,000 tons. Other deposits have been found but have not been thoroughly investigated. Large deposits of alunite (hydrous sulphate of aluminum and potassium) have been discovered in the Gandsha district, estimated to contain about 78,000,000 tons. Reduction of this ore is in the laboratory stage. Under the Five-Year Plan, construction of the first Russian aluminum works, with an annual capacity of 6,000 tons, has been started near Leningrad. Tikhvin ore will be used. Output will be increased to 20,000 tons annually as rapidly as possible. Should this output be attained, not only will the Russian market be closed to other countries, but Russia itself will have an exportable surplus that would have some effect on world production and price.

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Westinghouse Memorial Is Unveiled in Pittsburgh

On Oct. 6, a memorial to the inventor and industrial leader, George Westinghouse, was unveiled at Pittsburgh, Pa. The memorial was made possible largely by small contributions from 55,000 workers in the Westinghouse organizations in the United States, Canada, Europe, and Japan. The central panel of the memorial shows Mr. Westinghouse leaning over his drawing board and flanked on either side by the figures of an engineer and a skilled mechanic. Two wings, each consisting of three separate panels, carry depictions of Mr. Westinghouse's achievements. Standing well back from this group, and facing it, is the figure of an American youth. The monument is on a base of Norwegian granite and is made itself of gold-leafed bronze.

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Santa Maria Starts Mill

According to an official government report, Santa Maria de La Paz has installed a selective flotation plant at its property in the Matehuala district, San Luis Potosi, Mexico. The plant has a capacity of 250 tons of ore daily. Santa Maria has shipped its product direct to the Matehuala smelter of A. S. & R. heretofore, as the chief metal content is silver. Some copper and lead have been recovered in smelting operations.

Trepca Mines May Set New Record in Driving Tunnel

Driving of the new deep tunnel at the Trepca Mines property, in Yugoslavia, Europe, is averaging about 800 ft. monthly, believed to be a new speed record for work of this sort. The adit, when completed, will be 1¼ miles long. It is being driven through schist, with steel "timbers" in heavy ground, and a large drain is being made to take care of the expected heavy water flow. At the Ojuela unit of Compañia Minera de Peñoles, in Durango, Mexico, an average speed of 714 ft. per month was maintained for a 1-mile tunnel, with the best month showing 1,001 ft. This has been considered the fastest tunnel-driving job.

The new Trepca tunnel will cut the Stantrg orebody considerably below the present workings, thus adding to the tonnage developed, affording a new outlet to supplant the present cable tramway eventually, and permitting development of the orebody at even greater depth. Drilling has indicated that ore continues to at least the tunnel level. The adit may later be continued to cut the Meljenica and Trepca Hill deposits.

The new Trepca lead-zinc flotation plant, which was started in August, is already treating its rated capacity of 500 tons daily and may be brought up to 600 tons. Lead recovery is said to be averaging 95 per cent. The ore assays 11.5 per cent lead, 10.5 per cent zinc, and 3 oz. of silver to the ton.

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Corocoro United Closes

Closing of the properties of Corocoro United Copper Mines, in Bolivia, because of the low price of copper, has been announced in London. The company has also suffered from the revolution of last June and from labor troubles. It is the only important producer of native copper outside the Michigan district, in the United States, and is equipped with a 400-ton flotation plant.

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Close Penpoll Tin Smelter

Consolidated Tin Smelters has announced that its Penpoll plant, in England, will soon suspend work because of the drop in the supplies of Bolivian and Nigerian tin concentrates. The material that is still being received will be diverted to the Williams Harvey smelter, near Liverpool. Although Penpoll is a newer plant, the Williams Harvey smelter has five times its capacity.

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Build Line to Zinc Smelter

Construction of a branch line in Beaver County, Pa., by the Pittsburgh & Lake Erie Railroad to serve the zinc plant of St. Joseph Lead, now under construction near Bellowsville, has been authorized by the Interstate Commerce Commission. The line will extend from a connection at Monaca Borough southwest to a point near the mouth of Raccoon Creek in Potter Township, a distance of 3.5 miles. The estimated cost is $454,450, of which $127,130 is for land and $187,850 for grading. The lead company will advance $100,000 to finance construction. The new St. Joseph plant will be used for smelting zinc concentrate to come from St. Lawrence County, N. Y.

More Intense War Against Accidents Foreshadowed at National Safety Congress

Mining Section Meetings Particularly Well Attended—
Rush N. Hosler Elected General Chairman
—Excellent Equipment Display

H. D. KEISER
Assistant Editor

WITH more than 10,000 persons participating, the nineteenth annual Safety Congress and Exposition held at Pittsburgh, Sept. 29 to Oct. 3, was marked by an enthusiasm and seriousness of purpose that promised continued and more effective progress in the avoidance of accidents. Commendation of the efforts of the National Safety Council, as well as the vital necessity for such endeavor, was

R. N. HOSLER

stressed in the following message from President Hoover, which was read at the opening session of the congress:

"I deeply appreciate the value of the work of the National Safety Council in efforts to prevent the frightful loss of human life due to preventable accidents in industry and elsewhere. The death by accident of almost 100,000 persons in one year in the United States is a challenge to the resourcefulness of the nation to devise measures to eliminate this disastrous loss both of economic assets and of precious human values. Most of it is preventable, and your educational campaigns to teach the methods of such prevention are worthy of all praise."

The meetings of the mining section were particularly successful in that the attendance, in excess of 300 persons and double that of recent years, was composed largely of operating representatives. A well-balanced series of papers drew forth much animated discussion. Visits were made to plants in the vicinity and to an elaborate and extensive display of safety equipment, which was a popular feature of the congress. Some excellent entertainment rounded out the program.

In opening the sessions of the mining section on Sept. 30, H. C. Henrie, general chairman, remarked that ever since the organization of the section in 1915 he has been impressed by the increasing interest of the members and the results they have obtained in their accident-prevention endeavors. Mining, he said, can be made as safe as other industries; safety work is part of economical production, and companies that have made a real test of safety have benefited economically.

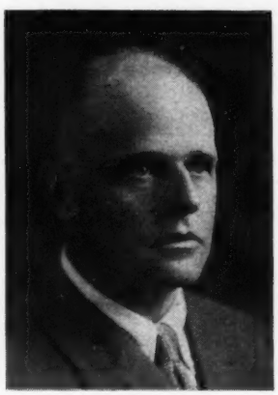
Reports of the various committees were then made. W. W. Adams, chairman of the statistics committee, said that the accident frequency record of the 162 mines participating in the national safety contest in 1929 was better than that for the previous year. Credit for the improvement belonged to the bituminous coal producers and to companies producing non-metallic minerals other than coal. The rate for the metal mines did not change materially, and that for the anthracite mines increased. The accident-severity rate for the 162 mines also showed an improvement compared with the previous year's record, and again credit for the improvement belonged to bituminous coal producers and the metal mining companies. Statistics furnished by the 162 mines applied to 28,000 employees and more than 82 million man-hours of exposure to mining hazards. The 162 mines comprised 24 anthracite properties, 66 bituminous, 54 metal mines, and 18 non-metallic operations.

The remainder of the morning was devoted to the presentation and discussion of five papers on safety responsibility. In the first, T. G. Fear described the "safety court" method of preventing personal injuries that the Consolidation Coal Company has successfully employed during the last four years. W. H. Comins, speaking on the safety responsibility of management and in answer to his own question: "What is the attitude of the executives of St. Joseph Lead Company and National Lead Company, the two operating companies in the southeast Missouri district?" first quoted Clinton H. Crane, president of St. Joseph Lead Company, as follows: "We have had a safety-first department for a long time. A real safety-first department means a school for your foremen, a school which will teach them that accidents are not necessary, that they are not a part of the mining business. But I think that there is no more important job in any one of our companies than the right man at the head of the safety-first department. The man who can sell the idea of taking care and keeping it sold; and I think safety first is one of the principal things that need selling all the time." And here, Mr. Comins said, is the attitude of Edward J. Cornish, president of the National Lead Company: Edward P. Durfee, representing the insurance department of National Lead Company, was talking some time ago to a group of underground employees. "Let me make this statement," he said. "If any man in this gathering, or any other man, can develop and guarantee a practical plan whereby all accidents can be prevented at this plant, or any plant, he need only present his idea to President Cornish and his board of directors for their immediate approval and authorization of necessary funds. The funds will be forthcoming, notwithstanding the fact that the necessary appropriation would greatly exceed present cost of compensation and accident-prevention work." In the opinion of Mr. Comins, management is the "drive wheel" in any safety campaign, and without its active cooperation and participation a full success cannot be expected.

J. B. Warriner, president, Lehigh Navigation Coal Company, stated in his paper that the number and continuance of hazards in the mining industry place the responsibility for safety on management. A. R. Pollock, general manager of mines, Ford Collieries Company, outlined the responsibility of the employer to his employees and their families in the building up of employee interest in safety endeavor.

The paper by W. V. DeCamp, general manager, United Verde Copper Company, was one of the outstanding papers of the meeting; it was read in abstract form by Mr. Harrington, secretary of the section, in the absence of Mr. DeCamp. In brief, Mr. DeCamp contends that management is solely responsible for safety, and that safety consciousness can only be instilled into workers following the education of management. Sound educational methods should be applied continuously, he says, and should be started among school children, because even though we may not attain maximum success with the present generation, we can hope for a better response from the coming generation.

In the discussion that followed these papers, Mr. Fear said that fines imposed for infractions of safety rules by the safety court, which he described, ranged from a minimum of 25c. to a maximum of $1. The amount of the fine was decided by the



P. G. BECKETT

judge of the court, but the violator also had recourse to jury trial. Only violations in which no injury was involved were tried by the court. F. C. Dunbar, Mather Collieries Company, pointed out that at a mine operating only one or two days a week the physical unfitness and worry that such an operating schedule caused the worker resulted in the occurrence of accidents, as well as in the inefficient operation of the property. H. T. Harper, of Tennessee Copper, stated, in answer to an inquiry, that all "near accidents," in addition to accidents involving an injury, were investigated thoroughly at the company's mines.

Following the election of officers in the afternoon, P. G. Beckett, Phelps Dodge Corporation, addressed the section on "Some of the Fundamental Requirements in Successful Accident Prevention Work." Looking back on the company's experience of the last five years, Mr. Beckett said he felt that the most interesting phase of safety work, and possibly the most important one, whether it be in mining or at an

industrial plant or in everyday life, is education. "I believe," he said, "that our safety committees have stressed this matter of education more than any other one point. If progress along safety lines sometimes seems slow to us, it probably is because of this feature of education, which in itself is a slow process and incapable of being rushed, as it is intimately tied up with the human equation, which is at the best uncertain.

"In connection with this important question of education I want to outline briefly the Phelps Dodge safety organization's experience, and to mention what now appears to us to be some of the most essential educational fundamentals. There must come first a recognition of what are unsafe practices, and the correction of them. We have insisted at all times with our men that the most efficient way to do a thing is the safe way, and vice versa. In analyzing accidents we have noted numerous cases where an employee through lack of education or instruction was doing his work in the wrong manner. It might be timbering or it might be blasting practice, or it might be the work of loading a car at a haulage chute, or it might be a section gang handling heavy rails, or it might be the starting and operating of machinery, or it might be a hundred and one other things. Usually we learned after the accident had happened that something was being done the wrong way and that nobody had told the workman the right way to do it.

"As a consequence, upon learning that unsafe practices on which the workmen had never been properly educated or instructed were a major source of accidents we started to make job studies of our different operations where accidents were occurring and where we felt that the practices could be standardized. We got together committees composed of superintendent, foreman, bosses and workmen, and studied all of the movements connected with a certain job or operation and agreed on what was the most efficient and safest method of performing the work. Having decided on that, rules were put into force regarding that particular practice, and the workmen throughout the mine or plant were instructed in the correct way of performing their work.

"Having recognized the hazard and standardized the practice along safe and efficient lines, and having properly instructed the workmen, the next step is to have correct supervision. It is not enough just to issue safety rules and instruct men. For a time at least there has to be close supervision to see that the correct methods are properly understood and are being carried out. So supervision is one of the links in this educational chain that cannot be neglected.

"Following proper supervision comes the question of placing the responsibility for an accident where it belongs. In the case of accidents that do occur after it is thought that all proper precautions have been taken and where ample instructions have been given, this matter of responsibility is something that has to be looked at and treated without fear or favor, and, whether it is the company's or the foreman's or the boss' fault, it must be squarely admitted and recognized, and steps taken to prevent a recurrence of a similar accident. Our committees always have made a point of investigating and analyzing every accident very carefully and trying to get as much light as possible on how it happened and then attempt to place the responsibility in the proper quarter. At the start there was a tendency to place the blame on 'trade risk,' or on the injured employee. However, after thoroughly analyzing such accidents we reached the conclusion that if the company did not take the trouble to ascertain the correct method of doing the work, and then instruct its employees, the company could not in all fairness place the blame for the accident at the door of the man himself. When at fault the company must be willing to shoulder the full blame and take the steps necessary to prevent a recurrence of that type of accident. So the careful analysis of all accidents, serious or slight, and the placing of the blame on the proper person or on the lack of safe practice, is one of the essentials and fundamentals of successful safety work.

"The next link in the chain after responsibility is discipline. If you are going to install correct practices, instruct the employees, and after an accident occurs place the responsibility where it belongs, you must have discipline. In order that safety rules will be strictly enforced discipline is a necessary adjunct to safety work and one of the fundamentals in the educational campaign. Regardless of whether it is a foreman, a boss, or a workman, if after instruction he fails to show the necessary interest or co-operation, or indicates signs of carelessness or repeatedly gets injured, it is necessary to use discipline.

"So in this matter of educational fundamentals, we have covered the following links, which, if properly welded together in a safety chain, will contribute greatly to the success of any safety campaign—at least they have in our case. To enumerate them once more, they are: (1) Recognition of unsafe practices, (2) correction of unsafe practices by studying the job and lining it up in the safest as well as the most efficient way, (3) proper instruction to all concerned in these correct and standardized practices, (4) sufficient supervision, (5) placing responsibility for accidents where it belongs, (6) discipline." In concluding his address, Mr. Beckett stated that the Phelps Dodge Corporation would be satisfied with its safety efforts only when it had entirely eliminated accidents. E. H. Denny, of the U. S. Bureau of Mines, then read a paper by W. D. Brennan, Utah Fuel Company, on "Methods of Educating Workmen."

A discussion of the two papers followed, in which K. L. Marshall, U. S. Bureau of Mines, called attention to the value and possibilities of the "any-language talkie-movie" in making job-analysis studies and in educating the worker. W. F. Sullivan, Phelps Dodge Corporation, stated that particular care should be exercised in making sure that the worker thoroughly understood the instructions given him.

A "question box" discussion led by F. C. Dunbar was then opened, the first subject being the analysis and classification of accidents. W. W. Adams stated that more information is needed on the effect of mechanization on the occurrence of accidents. Good statistics, plus acceptance of responsibility by management, he said, would result in safety in mining. Answering an inquiry made by R. H. Seip concerning chest X-ray examinations, Fred Nesbitt gave an outline of the X-ray examinations being made of workers in the Tri-State district. O. N. Wampler said that Eagle-Picher Lead, in studying each accident, attached to the recorded results of the usual investigation copies of the physical examination reports of all the persons involved in the accident.

The next morning the section visited the experimental mine of the U. S. Bureau of Mines, situated at Bruceton, Pa., where a series of tests were witnessed. In the afternoon D. L. Boyle, Associated Gas and Electric System, discussed "Safety Organization for a Small Company," and Carl T. Hayden, "Safety Organization for a Large Company." Both contended that "safety" is the same for large and small companies. Mr. Hayden stated that ten persons were killed on the hard-surfaced roads of Saline County, Ill., during the same period that seven fatalities occurred in the mines of the county. Mr. Henrie, Phelps Dodge Corporation, in referring later to this statement, said that the 1929 records of the corporation's benefit association showed that during the year employees experienced 232 off-duty accidents, as compared with 72 on-duty accidents. Apparently the miner was safer in the mine than on the highway or at his home. Mr. Henrie also said that mining can be made as safe as other industries.

B. D. Shove, Oliver Iron Mining, pointed out that the safety practice of the two companies discussed by Messrs. Boyle and Hayden included first-aid training for all employees. He inquired as to its value. J. J. Forbes, U. S. Bureau of Mines, said that of 305 large coal, metal, and petroleum companies which had used 100 per cent first-aid training, all reported obtaining favorable results. R. H. Seip criticised the practice of granting safety bonuses, saying that such action implies that the observance of safety precautions is additional to the other phases of the job. R. V. Hersey, Nevada Consolidated Copper, in the "question box" discussion that followed, averred that to obtain results in safety work employees must be convinced that the primary interest of those directing the work is in the welfare of the men themselves and their families.

On Thursday afternoon four papers on the problems of state mine inspectors were first presented. Then L. C. Lutton, H. C. Frick Coke Company, discussed "Protective Clothing in Accident Prevention Work in Mines." Among other suggestions, he recommended the use of molded metal toe caps for rubber shoes. In his paper "Safety Practices on the Witwatersrand," W. F. Buchanan, editor, *The Reef*, Johannesburg, South Africa, explained that the language problem which prevails on the Rand has always offered difficulty in the progress of the safety movement.

Newly Elected Officers of the Mining Section

General Chairman, Rush N. Hosler, Pennsylvania Rating and Inspection Bureau, Harrisburg, Pa.

Vice-chairman, W. H. Comins, St. Louis Smelting & Refining Works, National Lead Company, St. Francois, Mo.

Vice-chairman, Thomas E. Lightfoot, Koppers Coal Company, Pittsburgh, Pa.

Vice-chairman, A. W. Mendelsohn, Copper Range Company, Painesdale, Mich.

Vice-chairman, F. C. Dunbar, Mather Collieries Company, Mather, Pa.

Secretary and news-letter editor, Daniel Harrington, U. S. Bureau of Mines, Washington, D. C.

Complete Survey for Tunnel at Sunnyside Mining

Engineers of Sunnyside Mining & Milling, subsidiary of U. S. Smelting, Refining & Mining, operating a zinc-lead-copper property near Silverton, Colo., have completed a survey for a 10,000-ft. crosscut tunnel that will be driven from a point about 1 mile above the mill. This working will cut several veins at a depth several hundred feet below the Terry tunnel and reduce the cost of transporting ore to the mill by eliminating most of the present hoisting expense. At present ore is hoisted to the Terry tunnel, through which it is trammed to the cable tramway.

During the last fifteen months, development work has proved the continuation of the Washington and other major oreshoots at depth, justifying driving of the lower crosscut tunnel. Underground workings at the mine now exceed 60 miles in length. Ore reserves at present are sufficient to feed the 1,100-ton mill for two years. In August, production was 100 carloads of zinc concentrate, 72 carloads of lead concentrate, and 12 carloads of iron. Although operating at a slight loss, the Sunnyside continues to work rather than incur the expense of closing.

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A. S. & R. Subsidiaries Acquire British Columbia Properties

Premier Gold and Federal Mining & Smelting, both subsidiary companies of American Smelting & Refining, have been prominent in mining news from British Columbia. Premier has virtually acquired a controlling interest in Planet Mining & Reduction, is negotiating for the Pioneer, Lorne, and Coronation mines, and has suspended all work at Silverado. Federal Mining & Smelting has bonded a new silver-lead-zinc discovery on Vancouver Island.

Stockholders of Planet Mining & Reduction, which owns gold-silver-lead mines at Stump Lake, in the Nicola district, will be asked to ratify a proposal whereby Premier will obtain 52 per cent of the stock of a new company that will acquire the Planet properties in return for $100,000 and the remaining stock. Acceptance is expected. Premier will manage the properties and provide funds for additional development and equipment. Lack of power has handicapped production from the 120-ton mill. Concentrate produced between December, 1929, and July, 1930, contained 2,259 oz. gold, 53,594 oz. silver, 651,597 lb. lead, and 44,913 lb. copper. A small profit had been earned on the operation.

Negotiations for the Pioneer, Lorne, and Coronation gold properties on Cadwallader Creek, in the Bridge River district, depend on acceptance of the terms by the entire group, as Premier is not interested in operating only one or two of the mines. Production from the Pioneer property is running about $25,000 monthly, but the other mines are now idle. At the Silverado, in the Portland Canal district, work has been definitely suspended, as development has failed to show the persistence of the high-grade silver outcrop at depth. Work has been carried on for about two years.

Although the disappointing development of the Nimpkish Lake discovery on Vancouver Island, which Consolidated Mining & Smelting explored last year, has somewhat discouraged any too ambitious predictions, the area which Federal Mining & Smelting has taken over on the island is considered most promising. It consists of 25 claims, 17 miles north of Port Hardy, and it carries a series of mineral-bearing zones over a width of 2½ miles and an undetermined length. Thirteen zones have been found to date. Neither the width nor the grade of any of these zones has been published, but the statement has been made that they are of unusual width and that sampling indicates a good grade of milling material, even at present low prices. Equipment for further development is now on the way to the island.

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O'Brien Spikes Rumors of Suspension at Miami

Rumors that the copper companies operating in the Globe-Miami district of Arizona might be forced to close because of the drop in the price of copper were denied by T. H. O'Brien, general manager of Inspiration Consolidated, at a meeting of the Miami Rotary Club on Sept. 25. "I think there is no danger of the mines closing down," he said. "If that decision should be reached at any time, you won't hear it through any rumor. You will learn it through the regular news services when and if such information is given out by the board of directors in New York."

Mines in the Globe-Miami district are among the highest cost producers in the United States. Old Dominion, which is affiliated with the Phelps Dodge interests, and Inspiration, which is partly owned by Anaconda, have been operating on a curtailed basis since the beginning of the year. Miami Copper, an independent producer, however, is producing at a higher rate than in 1929 even though, at 10c., it cannot be doing better than break even.

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Caselton Shaft at Pioche to Be Sunk to 1,400 Level

Sinking of the Caselton shaft of Combined Metals, at Pioche, Nev., has reached a depth of about 1,000 ft. and will be continued to the 1,300 or 1,400 level. Construction work on a 1½-mile spur to reach this shaft is being started by the Union Pacific Railroad. According to E. H. Snyder, manager of the company, the shaft, which has four compartments, will be equipped with a 200-hp. Nordberg electric hoist, an 80-ft. steel headframe, and a 2,000-cu.ft. compressor.

Development of the Combined Metals limestone bed, which has produced considerable quantities of lead-zinc-silver ore, will be undertaken through the shaft. This horizon was cut in sinking at a depth of 840 ft. and a station is now being put in at that level to permit exploration of fissure intersections in the area near the shaft. On the bottom level, exploration will be carried on to the east of the shaft to explore the limestone bed where it has been displaced to depth.

About 6 miles west of the Caselton shaft, on the west side of the Comet range, the Forlorn Hope and Pan American shafts, 1½ miles apart, are being sunk by a syndicate composed of W. F. Snyder & Sons, International Smelting, and J. E. Jones, West Virginia coal operator. These shafts will also be used to explore the Combined Metals horizon. A station is now being cut on the 600 level of the Forlorn Hope. The Pan American, 1,300 ft. deep, is being continued to 2,400 ft. Between the 800 and 1,300 levels, the shaft cut low-grade mineralization.

■

Discuss Chemistry of Flotation at New York Section Meeting

Description of work now being done by the American Cyanamid Company in studying the chemical aspects of flotation was presented to the New York section of the A.I.M.E. at its first meeting of the season, on Sept. 24, by G. H. Buchanan, L. J. Christmann, and S. J. Swainson, all associated with the company in its work on reagents. About eighty members were present at the meeting, with Raymond Brooks presiding in the absence of R. M. Roosevelt, the chairman. Mr. Swainson, who spoke first, emphasized the growing scope of flotation, which was first used only for treatment of base-metal sulphides, but which has now been applied to nonmetallic minerals, oxidized lead and copper ores, precious metals, native copper, and mixed oxide-sulphide copper ore. The functions of the different kinds of reagents were described by Mr. Buchanan, the next speaker, who very cleverly compared the entire flotation process to a balloon ascension. To Dr. Christmann was left the task of discussing the atomic and molecular structure of reagents and minerals and of advancing the theories that have been evolved to explain chemically their affinity.

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U.V.X. Taxes Still in Dispute

United Verde Extension has paid the treasurer of Yavapai County, Ariz., its entire tax for 1930, amounting to $182,790, under protest and has filed notice of appeal to the superior court. The valuation upon which the county taxed the mine was fixed at $6,560,844. The company claims the value does not exceed $4,000,000. A similar protest was filed by the company last year, at which time Judge Fickett, of Tucson, presiding in the superior court, fixed the mine's value at $5,710,000. At present there is due the mining company from Yavapai County a $192,627 refund on its 1929 taxes. This has not been paid, as the decision of the superior court was appealed to the state supreme court by the county. In case Judge Fickett's ruling is upheld, interest amounting to almost $1,000 per month is accumulating against the county.

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Report Finding "Lost" Orebody

Diamond drilling on the property of Vulture Mining & Milling, near Wickenburg, Ariz., has struck a section of the orebody that had been "lost" through extensive faulting, according to D. R. Finlayson, president of the company. The property was a gold producer from its discovery in 1863 until exhaustion of the known ore, west of the faulted zone, in 1912. About $125,000 is said to have been spent in geological and exploration work within the last two years, with the result that two holes are reported to have passed through 40 ft. of vein material at a depth of 425 ft.

Trend of the Times

AFTER a last frantic attempt this week to sell the world back to the cave-men on the basis of a sheriff's auction, the bears in the commodity and security markets were routed by a revulsion to commonsense on the part of the business community. . . There has been a somewhat sheepish realization that though the high and justifiable hope of vigorous business recovery this fall seems to have gone glimmering, it does not follow that the world is going back to bows and arrows, buggies, cave-bungalows, and bear-skins. . . . Though still disappointing in its speed, gradual improvement in the general level of business activity continues, at slightly more than the seasonal rate. The *Business Week* preliminary index for the week ended Sept. 27 shows a further slow rise from 85.8 per cent of normal to 86 per cent. . . . The seasonal rise in industrial activity is still irregular and uncertain, but in general trade and in building it is more definite. Further improvement during October is fairly certain, but, without a sudden and decisive change in business psychology and banking policy, it is difficult to see from what source to expect trade to gather sufficient momentum in the next six weeks to carry us through the winter onto higher and firmer ground next year. . . . The economic aborigines and Puritan fathers who like long winters will enjoy this one.—From the *Business Week* of Oct. 8.

Treadwell Yukon to Build 300-Ton Mill at Bodie

Treadwell Yukon is increasing its exploration activities in the Bodie gold district of California. It has purchased three trucks and a gas-air shovel and is erecting a 300-ton mill. It is planned to use the power shovel in trenching operations, and all of the material thus removed will be hauled to the testing plant and treated. The mill scheme involves screening, waste rock sorting, and then grinding in a ball mill followed by flotation. Part of the equipment of the Clinton tailing operations, which are now defunct, is being utilized in the mill construction. The work of testing the débris upon the hill at Bodie has for its objective the search for hidden veins and also the testing out of the possibilities of working any considerable part of the gold-bearing surface material.

■

Seneca Suspends Production

Seneca Copper, operating in the Michigan district, has stopped operation of all stoping machines in both of its shafts, and underground work will be confined to development. The five-day week schedule will be continued. Only such copper ore will be sent to the mill as is taken out in development. The property, which adjoins the Ahmeek division of Calumet & Hecla in the northern end of the district, was reopened late in 1928, when the price of copper was rising. It has recently been shipping about 1,300 tons of ore daily to the Lake No. 2 mill, at Hubbell.

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Tonopah Mining Offers Lease

Tonopah Mining opened its mining properties at Tonopah, Nev., for leasing purposes on Oct. 3. Leases are being offered under terms similar to those at the Tonopah Belmont property. The Tonopah Mining properties have been closed since February, as a result of the drop in the price of silver, which is the chief metal constituent of the ore. Operation of the company's concentrator at Millers, 14 miles from Tonopah, has been maintained, but because the tonnage of custom ore available has been small, the company has raised its rates for milling from $4.50 to $5.50 a ton. The management hopes that by making the mine, which is known to contain some ore, available for production, a larger tonnage will be forthcoming.

■

Build Small Leaching Plant at Washington Copper Property

Construction of a 250-ton leaching plant for the treatment of copper ore will be undertaken by Twisp Mining & Smelting on the Alder group of 20 claims, near Twisp, Okanogan County, Wash. Development of this property has indicated ore to a depth of 500 ft. Three tunnels have been driven. Width of the orebody is said to range from 10 to 82 ft. and to average about 2.7 per cent copper and several dollars in gold. According to J. L. Magney, who sold the property to the company, about a three years' supply of ore is in sight. Work on building the plant is expected to start before the end of October. About 60 men will be employed. John Sawbridge, president of Sunshine Mining, and associates of Yakima, Wash., have formed the Twisp company.

■

Explore Coppermine River Find

Northern Aërial Minerals Exploration reports the discovery of high-grade bornite and chalcopyrite in the Coppermine River area in the Northwest Territory of Canada. Trenching has indicated a width of 12 ft. without reaching the walls, and a possible length of at least 3,000 ft. is also indicated. The discovery is north of the Dismal Lakes between the Great Bear and the mouth of the Coppermine River.

Development of New Ore at Waite Results Favorably

Under development, ore indicated by diamond drilling on the 500, 600, and 700 levels at the Waite-Ackerman-Montgomery copper-zinc property, in the Rouyn district of Quebec, is proving up satisfactorily, according to R. V. Porritt, mine manager. In addition, a new orebody has been struck between 800 and 1,000 ft. Shipments from the property have been suspended because of the low price of copper, although ore broken in development is being sent to the Noranda smelter.

Work done has shown two main bodies—"C," a lens apexing 25 ft. above and extending 60 ft. below the 500 level; and "E," an underlying lens, extending from 15 ft. above the 600 level to 40 ft. below the 700 level. In addition, several smaller bodies have been encountered. In all cases the bodies dip 20 to 30 deg. to the southeast, and strike northeast to southwest. In general, they are very irregular and intruded by many diabase sills.

Further work is necessary to prove these bodies in detail. At present "C" orebody has indicated an average width of 70 ft., and thickness of 40 ft., over a length of 225 ft.; and "E" orebody, an average width of 160 ft., and thickness of 40 ft., over a length of 225 ft.

Work on these levels has roughly delimited the ore mentioned in the foregoing, and geological conditions appear favorable to the existence of further orebodies in the same zone, and exploration work in this area is being carried on. A further orebody has ben located by diamond drilling from the 700 level in a zone at depths of 800 to 1,000 ft. from surface. The body at present shows a length of about 175 ft., and width of 160 ft. One diamond-drill hole in the center showed a thickness of 120 ft. of 9.5 per cent ore, and five further holes, spotted on the edges of the area described, showed thicknesses of 25 to 45 ft. of low-grade ore.

■

East Butte Closing Pittsmont

East Butte Copper is closing the Pittsmont mine, at Butte, Mont., according to R. H. Gross, president of the company, but decision as to whether the closing will be permanent or temporary has not yet been made. A decision will be made before the end of the year. The property has been producing about 4,000 tons of copper annually. Ore was treated by Anaconda Copper.

■

International Nickel Curtails

A second step in the direction of curtailment of operations due to the current depression in metal and industrial fields has been taken by International Nickel in laying off 350 men at the Port Colborne refinery, in Ontario. Several months ago, in the face of the rising production from the Frood mine, certain reductions were made in the operations of the company in the Sudbury district. These consisted of a reduction in Creighton tonnage, together with a decision not to reopen the Levack mine. Actual production of nickel and copper had not been curtailed, however. In view of the lower price of copper, together with the slackened demand for nickel, some such step had been inevitable for some time.

Colorado Geological Survey Completes Busiest Season

During the summer of 1930, the Colorado Geological Survey engaged in the largest program since the beginning of work in 1922, according to M. C. W. Henderson, who is in charge of the Denver office of the U. S. Bureau of Mines. The co-operative topographical and geological work has been and is being done by the U. S. Geological Survey personnel. Half the money to carry on the work is furnished by the State of Colorado and the Colorado Metal Mining Fund, the remainder being furnished by the U. S. Geological Survey. For the biennial period, July 1, 1929, to July 1, 1931, $37,500 of the co-operative money is being disbursed by the board of directors of the Colorado State Geological Survey.

The geological program was as follows: B. S. Butler, geologist in charge of the survey, started geologic work at Rico, assisted there by M. E. T. McKnight, who is remaining there to complete the work. W. S. Burbank and assistant continued the revision of the geology of the Ouray-Telluride-Silverton Triangle. Mr. Burbank's preliminary paper on this revision was distributed by the Colorado Scientific Society in August.

Charles H. Behre and assistant completed the geology of the western side of the Mosquito Range—north, east, and south of Leadville. Quentin Singewald and two assistants completed the geology of the east side of the Mosquito Range-Hoosier Pass, south of Mosquito Pass and east to Alma.

Tom S. Lovering and assistant continued their studies of the geology of the Front Range and began the revision of the geology of the Boulder County tungsten area. Mr. Lovering also spent two weeks with J. Harlan Johnson and David White in studying the Permian and Pennsylvanian horizons from Glenwood Springs to La Veta Pass and north to Fort Collins. E. M. Goddard and assistant made a geological examination of the gold and fluorspar deposits at Jamestown, Boulder County. J. W. Vanderwilt started geologic examination in the Elk Mountain Region of Gunnison County, tying up the geology of Aspen with Taylor Park, Snow Mass, and Crested Butte areas. J. Harlan Johnson made a stratigraphic study of the Pennsylvanian formations from Salida, north through Trout Creek, Weston Pass, Kokomo, Tennessee Pass, and Battle Mountain, in which work he had the advice of Dr. David White.

Dr. B. S. Butler, in addition to his duties of supervising his staff mentioned in the foregoing, found time to make many geological reconnaissances throughout the state.

C. A. Ecklund was in charge of the topographic work in Colorado. He completed a topographical map of an area of about 20 square miles at Rico on a scale of 1:12,000. Later in the season he returned to Red Mountain to continue the large-scale mapping of the Ouray - Telluride - Silverton Triangle, upon which he has been working the last two years.

Stuart Penick and assistants completed about 40 square miles of the area between Marble and Schofield Pass on a scale of 1:48,000, and the topographic mapping of the Mount Powell No. 3 sheet, covering 225 square miles of the Gore Range, on a scale of 1:48,000.

Pewabic shaft of Peru Mining at Hanover, N. M., just put into production

R. R. Monbeck and assistants completed about 5 square miles of the Sugar Loaf and St. Kevin area, west of Leadville, and about 8 square miles of the Kokomo district—both on a scale of 1:12,000. Mr. Monbeck also completed a topographic map of the Lost Park Reservoir site, northwest of Cheesman Dam. R. C. Fisher and assistants completed about 10 square miles of a topographic map of 20 square miles of the Boulder tungsten area, on a scale of 1:12,000.

Fortunately very little triangulation preliminary to topographic mapping was necessary in the summer program of 1930. However, third-order levels were run by E. W. Gouchenour in the Mount Powell No. 3 area, and a third-order level line from Parlin to Pitkin, thence up to Quartz Creek to Tin Cup to Willow Creek Ranger Station, in Taylor Park.

In addition to W. S. Burbank's revision of stratigraphy at Ouray and its bearing on the ore deposits, which was off the press in August, an economic geologic paper on the Gilpin-Clear Creek County region by T. S. Lovering will soon follow in the proceedings of the Colorado Scientific Society.

On June 28, Dr. B. S. Butler presented before the Colorado Scientific Society his paper on the molybdenum deposit at Climax, and his manuscript is ready for printing.

During the summer of 1930, a geologic map in black and white of the east side of the Mosquito Range, and of cross-sections, was issued.

Mr. Burbank's professional paper on the Bonanza district, in Saguache County, has passed the editors of the U. S. Geological Survey, but still has to go through the government office. Mr. Lovering's report on the Montezuma Quadrangle has reached the editors of the Survey.

■

A. S. & R. Examines Silver Lake

American Smelting & Refining has been examining the Silver Lake mine, near Silverton, Colo., a group of nearly 130 claims which have not been worked, except spasmodically, for the last 24 years. Men have been employed recently by the company to clean out the old Scranton tunnel and laterals, and a survey has been made of the vein system.

Peru Mining Starts Shipping From New Pewabic Shaft

Production has been started from the Pewabic shaft of Peru Mining, a subsidiary of Illinois Zinc, at Hanover, N. M. The shaft, which has three compartments, was sunk following the discovery, by diamond drilling, of three separate lenses of lead-free zinc sulphide ore, one above the other. They range from 15 to 35 ft. in thickness and carry from 8 to 20 per cent zinc. The dip from the horizontal is from 35 to 45 degrees.

At present the Pewabic shaft is bottomed in ore at a depth of 280 ft. The first lens of ore was cut at 217 ft., is 35 ft. thick, and is now being mined at the rate of 200 tons daily. A double-drum electric hoist handles 3-ton skips and is capable of hoisting 50 tons per hour. The steel headframe contains an 18x24-in. jaw crusher, which crushes to a maximum size of 4 in. From the 400-ton storage bin, ore is taken by belt conveyor to a cable tramway that delivers it to the railroad.

The ore is milled at the company's mill, near Deming, 55 miles from the mine. A high-grade concentrate is made and shipped to the Illinois Zinc smelter at Peru, Ill. About 40 men are employed at the mine and about 20 at the mill, under the direction of P. H. Argall, manager of the New Mexico division of the company.

■

St. Louis to Drive Tunnel Through Rico Holdings

St. Louis Smelting & Refining, the main operating subsidiary of National Lead, has completed plans for driving a tunnel 6,000 ft. long, 9 ft. wide, and 7 ft. high, to open up at depth its lead-zinc veins in the Wellington group at Rico, Colo.

The tunnel will go through the north end of Nigger Baby hill and under the west slope of Telescope Mountain, adjoining. It will also go through about 2,000 ft. of the Falcon group of Falcon Lead Mining. It will be started below the level of the tracks of the Rio Grande Southern Railroad. Shipments from the Wellington have been averaging as high as 50 per cent combined lead and zinc content and some even higher.

■

Copper Range Cuts Output

Production of Copper Range, operating the Champion and Baltic mines, near Painesdale, Mich., has been cut about 10 per cent by putting the properties on a two-shift basis, instead of the three shifts formerly worked. This announcement, following the news that Calumet & Hecla is now on a five-day week and that Seneca has suspended stoping operations, indicates that output of copper from the Michigan district, which has until recently been well maintained despite the drop in the price, will show an appreciable decline for the remainder of the year. Copper Range will continue to operate six days a week, and only a small number of men have been discharged, others being retained on a part-time basis. The company's normal production is about 2,000,000 lb. of copper monthly from about 60,000 tons of ore.

Benguet and Balatoc Increasing Output of Gold From Philippine Islands

C. M. Eye
Mining Engineer, San Francisco

MOST of the gold produced in the Philippine Islands continues to come from the Benguet district, in which Benguet Consolidated is the leading producer, with Balatoc a fairly close second. Their production is now showing a substantial increase over the 1929 record. Benguet output in 1929 was $1,514,196 from treating 97,400 tons of ore of an average grade of $16.60 a ton—a recovery of $15.54 a ton. The total operating cost per ton was $6.48 and net profit was $8.45 per ton.

During the first six months of this year, 52,962 tons was treated, with a production of $860,618, or $16.25 per ton, at a total operating cost of $7 and an actual profit of $9.25 per ton. Ore reserves as of June 30, 1930, amounted to 329,690 tons, of a total estimated gross value of $4,050,650, or $12.28 per ton. These reserves are all above the 600 level.

The camp, known as Antamok, is about 7 miles from Baguio, at an elevation of 3,000 ft., and has a population of about 3,000, mainly Igorotes and Filipinos, possibly 800 of whom are employees. The white staff numbers about 15, the married members being comfortably housed in cottages, free of cost, and the single men in a fine new clubhouse. Timber is brought in over a cable tram about 2 miles long, with a portable sawmill operating at the upper terminus.

Erection last year of a new steel headframe, replacing the wooden one erected in 1918, and installation of a new double-drum hoist of 6,000-lb. rope pull, good for a depth of 1,200 ft., have greatly increased hoisting capacity.

Colbath drainage tunnel, begun in January, 1927, and completed in December, 1928, at a cost, including the purchase of special equipment, of about $250,000, serves to drain the mine to the 700 level as well as providing a means of disposal of surplus waste from development work. It is 8x8 ft. in the clear and 7,094 ft. long from the portal to the connection with the shaft. This drive has been extended west to a point 1,625 ft. from the shaft, paralleling the main vein formation in the hanging wall. Near the face a mineralized zone was cut, of which 7 ft. in width assays $15 per ton. Crosscuts to the north to intersect the main vein system are being driven at two points on this west drive, to be followed by diamond drilling.

The shaft is down 1,130 ft. below the collar. Stations have been cut on the 900, 1,000 and 1,100 levels and pumps installed, though very little water was encountered in sinking below the 700, or drainage, tunnel level. From these stations the area heretofore unexplored, except by diamond drilling several years ago, will be opened up. As the drilling gave evidences of considerable ore of good grade, the management hopes that this work will materially increase the ore reserves. Development continues in the hanging-wall area of the upper levels in which most of the ore that has maintained the reserves during the last few years has been found and the possibilities of which have not been exhausted.

Balatoc Mining property, controlled by Benguet Consolidated, is 5 miles from Antamok, to the south, and about 10 miles from Baguio. There is a good road from Baguio to the mill site. A 1-mile tramway connects mine and mill. Both camps are well laid out and equipped. The mill, which began operating early in 1929, is now handling about 140 tons per day, grinding in water to 150 mesh, followed by filtration and subsequent cyanidation, with extraction of about 90 per cent. Additions have been and are still being made to the mill equipment in an endeavor to better the extraction.

During the first half of 1930, 24,365 tons was milled, yielding $593,492, or $24.35 per ton, with an operating cost of $11.42 per ton. Ore reserves, as of June 30, 1930, were reported as 165,952 tons, of an estimated gross value of $3,689,086, or $22.23 per ton.

Mining costs at Balatoc are necessarily high because of the three widely separated vein systems that carry the narrow orebodies. Complicated treatment makes the milling costs also rather high. It is, therefore, essentially a mine that must depend upon high grade for profit. Present workings are comparatively shallow, but diamond drilling to a depth of several hundred feet below them indicates no general drop in value.

A new turbine installation on the Agno River, about 8 miles by air line from Antamok and 12 from the Balatoc mill site, supplies electric energy to both properties. This plant consists of two units of 500 kw. each, with provision for the addition of a third when needed, operating under 90 ft. net head. The current is generated at 2,300 volts and transmitted at 23,000. Owing to the unusual conditions at the site during the rainy season, the generating station is located underground, and a settling cone, 80 ft. in diameter, with large discharge pipes and valves at its apex, separates sand and gravel from the water before it goes to the wheels.

Benguet Consolidated still retains its high-head hydro-electric plants for use on occasion as stand-bys and has, besides, a stand-by Diesel plant; and Balatoc is installing a Diesel engine and generator of sufficient capacity to operate the treatment portion of the mill in an emergency.

The only other property now contributing to production in this district is that of Itogon Mining, east of the Balatoc property and apparently on the same vein systems. The owners are engaged in an active development campaign, and I understand it is their intention to replace the old mill with a modern plant on the Itogon River, should results warrant the building of a new structure and the installation of the new equipment.

The old Headwaters mine is being reopened by Baguio Gold Mines, recently organized in Manila for this purpose. Several minor developments are going forward, including that of the Hartwell group, on Kias Hill, by Benguet Consolidated. It has an excellent showing. The possibilities of the district have by no means been exhausted.

Phelps Dodge Safety Record High During August

The five branches of Phelps Dodge, in Arizona, Mexico, and New Mexico, hung up a new record for the month of August, when a total of only five lost-time accidents were reported. It is the best mark obtained for a period of a month since the safety contest between branches was started, several years ago, and is all the more remarkable as August is a 31-day month. The Morenci branch led the group with no lost-time accidents; Copper Queen, Moctezuma, and Stag Cañon were each charged with one mishap. The other two accidents occurred at the Old Dominion mine, in Globe. Four of the five accidents for the month occurred underground and the fifth accident was on the surface.

The Morenci branch, in addition to winning the month's honors, is heading the contest for the year with 10 lost-time accidents to date since Jan. 1, or 0.034 per 1,000 shifts. Old Dominion, at Globe, ranks second, with seven accidents, or 0.041 per 1,000 shifts; Copper Queen, with 22 accidents, or 0.044 per 1,000 shifts, is third; Moctezuma, with 16 accidents and a decimal rating of 0.049, is fourth, and Stag Cañon, with 12 accidents, or 0.141 per 1,000 shifts, is last.

■

Coal Companies Take Honors in Louisville Safety Meet

First place both in the first-aid and the mine rescue contests at the International First-Aid and Mine Rescue Contest for 1930, held at Louisville, Ky., under the auspices of the U. S. Bureau of Mines, went to coal-mining companies. The meet was held on Sept. 16-18 and was attended by 57 first-aid and seven mine rescue teams. The Mahan-Ellison Coal Corporation, of Liggett, Ky., won the first-aid contest and the Consolidation Coal Corporation, of Carolina, W. Va., took first place in mine rescue work. Utah Copper and Phelps Dodge were represented by first-aid teams.

■

May Drill Clifton Property

A comprehensive examination of the United States Copper properties, near Clifton, in the Morenci district of Arizona, is being made by engineers of the M. A. Hanna Company, of Cleveland, which recently acquired the property through M. C. Lake. No purchase price has been made public, although reports that it was $300,000 have been heard. Diamond drilling will probably be started within a short time. The Hanna company has been largely engaged in mining of iron ore up to the present.

■

Ward's Museum Is Burned

A fire destroyed scientific specimens valued at $200,000 in Ward's Museum, at Rochester, N. Y., on Oct. 1. The museum contains what is considered to be the most complete exhibit of mineral samples in the country.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Continue to Increase Rate of Underground Work in Rhodesia

London, Sept. 1.—The rapid increase in the rate of the development work being done underground in Northern Rhodesia is now the principal feature of work there, as exploration activities have subsided somewhat. Three mines are now preparing for stoping—Roan Antelope, N'Kana, and Mufulira—and all three are finding that the rate of driving crosscuts and drifts is steadily accelerating as the efficiency of native labor improves. The mines are far ahead of their schedules, thus assuring their readiness to furnish ore for the concentrators as soon as they have been built.

. . . . Roan Antelope, which is the furthest advanced of the three, is expected to show an increase of 50 per cent in the footage of workings driven during September over August, and 3,882 ft. were driven in August. Construction of the concentrator, to have an initial capacity of 5,000 tons and an eventual capacity of 15,000 tons daily, is also being pushed. Nine ball mills have already been put in place and half the foundations for the flotation machines have been completed. Excellent progress is also being made at N'Kana and Mufulira, both of which are building 6,000-ton plants.

. . . . Plans for the development of the high-grade orebody that has been opened up in the adjoining areas held by Rhodesian Congo Border Concession and N'Changa Copper are expected to be announced officially within the next few weeks. This orebody, which is estimated to contain more than 50,000,000 tons of ore averaging 8 per cent copper, will probably be worked jointly by the two companies, but as yet no details concerning the rate of exploitation or the method of treatment have been made available. Preparations for production have already been started, it is understood.

■

Huanchaca Recoveries Excellent From Zinc-Lead-Copper Ore

La Paz, Bolivia, Sept. 27.—Compañia Huanchaca de Bolivia is said to be making an excellent separation of lead, copper, and zinc in its new selective flotation plant at Pulacayo, started in January of this year. The silver content of the ore is now being recovered in the lead and copper concentrates instead of by the lixiviation plant. Average grade of the ore is about 12 per cent zinc, 4 per cent lead, and 0.5 per cent copper, as well as 16 oz. of silver. The flotation plant, built last year with a capacity of 400 metric tons daily, is being gradually stepped up to 700 tons. About 3,000,000 tons of ore is in sight.

. . . . Operating two shifts, of sixteen hours a day, the Huanuni tin dredge produced 160 tons of fine tin in August at a very satisfactory cost. This indicates an annual producing capacity of 3,000 tons on a three-shift basis. The dredge started operations early this year. Reports from Catavi state that a strike by workers at the properties of Patiño Mines & Enterprises, largest tin producer in the world, has been arranged. Because of the tin market, the company has been forced to work its men on a four-day shift.

■

Tin Dredges Resume Work in Eastern Areas

Melbourne, Sept. 27.—Operation of tin dredges in Federated Malay States and other Eastern tin-mining areas has been resumed after two months' suspension by the larger, low-cost units. Among the plants that are working again are Rawang, Kuala Kampar, Changkat, Rawang Concessions, Kramat, and Kundang. Many of the smaller companies are unable or unwilling to resume, however, because of the present low price of tin.

■

Plans for Financing Grootvlei Now Under Consideration

Johannesburg Sept. 29.—A scheme is now being considered whereby African & European Investment will co-operate with Anglo-American Corporation of South Africa and Union Corporation for the development of the Grootvlei property on the Far East Rand. African & European Investment, which is the holding company of the Lewis and Marks interests, now owns about two-thirds of the 611,770 issued shares of Grootvlei Proprietary Mines. The property consists of 7,241 acres adjoining the East Geduld and Daggafontein mines to the east. Both of the latter properties are now under development, with plans for starting production within two or three years. East Geduld is controlled by Union Corporation and Anglo-American has a large interest in Daggafontein, so that the entry of these two finance houses into the Grootvlei enterprise indicates that early development is likely to be carried on from the adjoining properties.

. . . . Boreholes drilled on the Grootvlei property by a prospecting syndicate struck the Van Ryn reef at a depth of 3,340 ft. at the western boundary and 2,500 ft. at the eastern boundary. Two shafts, 5,600 ft. apart, have been sunk to depths of 378 ft. and 55 ft., respectively. Owing to inrush of water, operations were suspended. When sinking is resumed, the reef is expected to be cut at about 3,000 ft.

. . . . In its forthcoming report, the government commission on miners' phthisis will probably recommend that the Union of South Africa government contribute about £250,000 annually toward the total required for phthisis compensation. At present, the burden is born entirely by the mining companies now operating on the Rand. In the last fiscal year for which figures are available (that ended March 31, 1929), the total payments made were £829,500, distributed among 35 mining companies. Inasmuch as many of the beneficiaries of the compensation were employed on mines that have long since closed, the operating companies feel that to ask them to bear the entire burden is unfair.

. . . . Increasing activity is being shown along the Black reef, on the West Rand, where several small mines have started development work. No new producers of importance have been developed recently in this area.

■

Small German Copper Plant Forced to Close

Berlin, Sept. 29.—Stadtberger Hütte A.G., one of the smaller German copper producers, has been forced to close because of the continued decline in the price of the metal. The copper situation is viewed as hopeless by the company, which operates a small smelter and refinery at Niedermarsberg, Westphalia, and produces a small quantity of lead ore as well. The fate of Mansfeld Copper, which is the largest German producer, is still uncertain, because of the weakness of the government finances. Payment of the subsidy, promised by the government when operations were resumed after the strike in June, appears doubtful as a result of the fiscal difficulties in which the administration finds itself. Copper production in Germany, nevertheless, was 11,543 metric tons in August, compared with 9,805 tons in July. Of this total, the smelter output from ore and concentrate was 5,247 metric tons, compared with 4,202 metric tons in July.

. . . . Despite the great drop in the imports of minerals and metals, German exports of semi-manufactured metal products continue to show a substantial gain in quantity over the corresponding periods of 1929. For August, exports in this class were 8,597 metric tons, valued at 12,832,000 marks, as compared with 6,217 metric tons, valued at 12,479,000 marks, in August, 1929. The drop in the value of metals is strikingly shown by the average value per metric ton—1,490 marks in 1930 and 2,010 marks in 1929. In July, 1930, exports were 8,664 metric tons and in July, 1929, 6,165 metric tons.

. . . . German lead production increased to 10,192 metric tons in August, compared with 8,292 tons in July. The outlook for the lead market, which has so far been the most stable of any of

the major non-ferrous metals, is not considered favorable here. Stocks of about 160,000 metric tons of the metal are alleged to be held by producers, chiefly American, English, and German.

. . . . A reduction in European aluminum prices is expected in October and may amount to as much as 15 per cent. Paradoxically, aluminum users are protesting against this step, since it will diminish the value of the large stocks of manufactured material they have on hand. Aluminum of alleged Norwegian origin is being offered in Germany by the American Mellon interests, despite the heavy tariff of 250 marks per metric ton that has recently been put on imports of the metal.

. . . . Aluminum-Industrie, of Neuhausen, Switzerland, has been given permission by the European cartel to enlarge the capacity of its plant at Rheinfelden, Baden, from 2,400 to 4,000 metric tons of aluminum annually.

■

Rosebery Unit May Not Start; Broken Hill South Report

Melbourne, Sept. 27.—H. St. J. Somerset, general manager of Electrolytic Zinc, has announced that the company had hoped to start its Rosebery mill, near Zeehan, Tasmania, in January, but that unless metal prices improve sufficiently, or costs can be materially reduced, a definite possibility exists that operations will be completely suspended at this unit. The Rosebery mill has a daily capacity of 550 short tons of ore averaging 22 per cent zinc, 6 per cent lead, and 7.5 oz. of silver per ton. It was built following successful development of the company's mines at Mount Read and Rosebery and operation of a 100-ton pilot plant. Concentrate was to be shipped to the Risdon plant, now being enlarged to a capacity of about 70,000 tons of zinc annually. Possibly the company's entrance into the European zinc cartel has influenced the decision to postpone starting the mill, as ample supplies of concentrate for continued operation at the present rate of zinc production are available from Broken Hill, where a large quantity of zinc concentrate is stockpiled.

. . . . The annual report of Broken Hill South, just issued, shows that the company earned less during the year ended June 30, 1930, than in the preceding year, despite larger production and greater efficiency. Figures given in parentheses are for the year ended June 30, 1929. Profit was £282,268 (£358,259) of which £107,206 came from investments (£115,148). Production was 337,440 long tons of ore (318,700); 68.931 long tons of lead concentrate (64,055); and 63,457 long tons of zinc concentrate (60,541). Recovery of the metal content was the highest ever recorded, 94.8 per cent of the lead (93.8 per cent), and 83.1 per cent of the zinc (82.2). Broken Hill South sold its zinc concentrate under the Board of Trade contract until June 30, so the drop in the price of zinc was not reflected in the report. Lower profits resulted entirely from the drop in the prices of lead and silver, as working costs were reduced from 37s. 7.2d. per long ton of ore treated to 35s. 4d. Zinc is no longer being recovered from the Broken Hill South ore.

. . . . Completion of part of the central power plant, being built by the Broken Hill mining companies, is expected in June, 1931, according to the Broken Hill South report. The entire plant, composed solely of Diesel engines, is expected to be in operation by December, 1931, and marked economies are hoped for as a result of the substitution of oil for coal as fuel.

. . . . Three companies have recently been formed to exploit gold deposits in Victoria and Queensland, a further indication of the reviving interest in gold mining. An English syndicate, known as Carngham Freehold Gold Estates, has taken over 10,593 acres of auriferous ground at Carngham, Victoria. Aporama Land Minerals, Ltd., controlled by English and French interests, has undertaken development of the old Palmer gold field, in north Queensland, which has been idle for the last thirty years. The company will spend £100,000 in exploration work. Gold Mines of Australia, Ltd., with a capital of £500,000, has been formed to take over the Mount Coolon mines, in Queensland, from Austral Development. Broken Hill South, Zinc Corporation, and North Broken Hill are interested in the company, which is now doing underground development work at the properties. Production is more than half that of the entire state, or about 500 oz. monthly.

. . . . Two drill holes put down by the South Australian government at the Wallaroo mines, 12 miles north of Moonta, South Australia, have cut a new copper lode. The two holes are about 200 ft. apart. Funds for this work, to the extent of £5,000, were advanced by the dominion government. Production from Wallaroo was suspended in 1923.

. . . . Because the state government has not the funds at present to advance for construction of the railroad from Queanbeyan to Captain's Flat, where Lake George Metal has developed a large lead-zinc-copper deposit, the company may build the line itself. The distance is about 28 miles. F. L. Thomas, manager of the company, is now in London discussing the situation. T. M. Owen is in charge during his absence. The staff and expenditures at the property have been reduced to a minimum, pending final decision.

. . . . Construction of the new Palmer River gold dredge, which will operate at Strathleven, in northern Queensland, has been completed. The dredge has a capacity of 50,000 cu.yd. per month and it was built by Chas. Ruwolt & Son, of Melbourne. About 3,000,000 cu.yd. of gravel has been indicated by drilling.

■

High-Grade Find Made Near Yarri, Western Australia

Kagoorlie, Western Australia, Oct. 1.—A new gold strike has been made, 24 miles northeast of Yarri. It is said to assay 3 oz. of gold per ton, and the lode has been traced on the surface for 1,200 ft. Yarri is not far from Edjudina, where the Patricia property is being developed by Kimberley Oil. A state battery is maintained at Yarri.

. . . . Great Boulder Proprietary is now handling ore carrying as low as 5 and 6 dwt. of gold per ton from its 600, 800, and 900 levels. This is considerably lower than the average grade of ore in the mine, as the reserves are estimated to be about 80,000 tons of 9.7 dwt. ore. The company handles about 250 tons daily. Last year, on ore of average grade, a profit of only £14,808 was made, indicating that costs have been reduced to make treatment of lower-grade material possible.

. . . . South Kalgurli, which has been operating the Croesus Proprietary under lease for the last year and a half, has taken a ten-year lease on the property from Oroya Links. The shaft has now been deepened to 1,150 ft. and development work has indicated ore averaging 8 and 9 dwt. of gold per ton. About 1,200 tons of ore a month is being extracted from the lease. In the South Kalgurli mine itself, development has put several years of ore in sight, but the lode evidently does not continue at depth. Altogether, the mill is handling 8,500 tons of ore monthly.

. . . . Five lease areas in the Lake View & Star property have been taken by the South syndicate. This syndicate has struck a new lode on the 375 level of the property. Operations through the Horseshoe main shaft have been entirely suspended by Lake View. The hoist has been moved to the Chaffers shaft.

■

Rio Tinto Cuts Dividend; Report on Gold Supply

London, Oct. 2.—Rio Tinto, copper-sulphur producer operating in Spain, has cut its interim dividend from 25 to 10 per cent, owing to the decline in the price of copper and the discount for which pyritic sulphur must be sold in competition with brimstone. The company reports a shrinkage of 34 per cent in gross trading profit for the first half of 1930 and expects even a greater shrinkage in the second half.

. . . . Despite four years' work developing sulphur deposits in southern Spain, Tigon Mining Corporation is not yet producing. The company has just acquired control of sulphur mines near Arica, Chile, which have a present annual output of 9,000 long tons of refined sulphur annually. This move is believed to indicate unsatisfactory results in Spain, but no official statement has yet been made.

. . . . An interim report by the commission on gold of the League of Nations states that the gold supply for monetary purposes will be inadequate by 1934. Unless unexpected new sources are forthcoming, the decline will be accelerated after 1940 owing to the gradual exhaustion of the Witwatersrand. London replies by subscribing funds for the investigation of new gold fields, notably in Australia, Panama, and New Guinea, at a time when mining shares generally are selling at big discounts.

. . . . Leading platinum producers are negotiating an agreement to abolish competitive selling to prevent further declines in price. Transvaal representatives are demanding a quota for output from their mines that is considered exorbitant by Russia and Canada, the lowest-cost and largest producers.

MARKET AND FINANCIAL NEWS

American Smelting & Refining's Income Off in Six Months

The American Smelting & Refining Company reports for the six months ended on June 30 a net income of $6,879,441 after all charges and reserves, equivalent, after preferred dividend requirements, to $2.74 a share on 1,823,136 shares of common stock. This compares with $10,947,501 in the first six months of 1929, equal, after all charges and reserves, including preferred dividend requirements, to $5.03 a share on the outstanding common stock. The surplus income, after deducting common and preferred dividend payments, was $1,356,411, compared with $5,537,621.

On June 30 the company had on hand, in cash, demand and time loans and United States government securities, $35,280,791, a gain of $8,612,048 since the close of 1929. Total current and miscellaneous assets were $99,898,811, compared with current liabilities of $19,306,128. On Jan. 1 current and miscellaneous assets were $90,803,101 and current liabilities $22,240,087. Metal stocks on June 30, carried at cost or market, whichever was lower, amounted to $41,235,406, against $47,617,204 on Jan. 1.

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Phelps Dodge Takes Over National Electric

The Phelps Dodge Corporation announced on Sept. 22 that it had acquired control of the National Electric Products Corporation, a leading manufacturer of copper and other metal products for the electrical and building industries. The merger rounds out plans of Phelps Dodge for control of subsidiaries in every phase of the copper business. National Electric is credited with an annual capacity of more than 200,000,000 lb. of fabricated copper products and 150,000 tons of steel products.

Louis S. Cates, president of Phelps Dodge, will become vice-chairman of National Electric Products, and officials of the latter company will become directors and members of the executive committee of Phelps Dodge, according to the plans announced.

Stockholders of Phelps Dodge have approved an increase in capital stock from 2,000,000 to 3,000,000 shares of $25 par value each. One purpose of the increase was to provide stock for acquiring the Nichols shares, announced previously, on a share-for-share exchange basis. This would require 222,000 shares of Phelps Dodge stock. Holders of a majority of the shares of Nichols Copper have signified their intention of making the exchange.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54
1928	99.78
1929	110.33

	1928	1929	1930
January	97.54	106.86	102.94
February	96.73	110.37	102.28
March	96.22	122.71	99.93
April	97.14	116.36	93.24
May	99.05	110.03	83.41
June	100.16	109.66	78.57
July	99.69	109.58	74.58
August	99.85	109.81	74.41
September	100.53	109.29	73.42
October	102.34	108.52	.....
November	103.83	106.09	.....
December	104.28	104.75	.....

■

Lake Shore Profits Up

Lake Shore Mines, largest gold producer in the Kirkland Lake district of Ontario, made a net profit of $3,128,985, after deductions for taxes and depreciation, in its fiscal year ended June 30, 1930. Corresponding profit in 1929 was $2,540,159. The increase resulted partly from an increase in production of more than a million dollars, to $6,567,780, and partly from decreased costs, which were $6.94, including depreciation charges, compared with $7.15 in the preceding year. The company handled 467,648 tons in its mill. Nearly $2,000,000 has been spent on the improvement program that has been carried on during the last two years; nevertheless, the company's total current assets were put at $1,935,534, compared with $2,331,446 in the year preceding. Current liabilities are $615,686.

Copper Producers Announce Lower Dividend Rate

Because of the prevailing low price of copper, three producers have omitted dividends and two announced reductions.

The Anaconda Copper Mining Company declared a quarterly dividend of 62½c. a share, placing the stock on a $2.50 annual basis. Three months ago Anaconda declared a quarterly dividend of 87½c. For the five preceding quarters the company had paid $1.75 quarterly.

Andes Copper declared a quarterly dividend of 25c., against 37½c. three months ago and 75c. for each of the six preceding quarters.

Inspiration and Miami have also omitted declaring their quarterly dividends due at this time. Three months ago Inspiration declared a quarterly dividend of 50c., and Miami 37½c. For the five preceding quarters the dividends were $1 quarterly for each company.

Greene Cananea also passed its dividend. Three months ago Green Cananea declared a quarterly dividend of 75c. For the preceding five quarters the company had paid dividends of $2 a share.

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Wold Zinc Production Shows Little Change

Zinc production for all countries except Belgium, Poland, and The Netherlands totaled 93,185 tons in August, against 92,771 tons in July, and 96,303 tons in June, according to the American Bureau of Metal Statistics. Production statistics, in tons, follow:

	June	July	August
United States	43,473	40,038	41,029
Mexico	2,669	3,096	2,938
Canada	9,204	8,978	9,749
Belgium (a)	.....	.....	.....
France	8,154	8,096	7,766
Germany (b)	9,668	9,413	9,255
Great Britain	4,691	5,008	4,532
Italy	1,552	1,857	1,688
Netherlands (a)	.....	.....	.....
Poland (a)	.....	.....	.....
Spain	957	984	1 005
Australia	5,107	5,243	5,243
Rhodesia	1,828	1,758	1,680
Elsewhere (c)	8,000	8,300	8,300
Totals	96,303	92,771	93,185

(a) Not reported. (b) Includes zinc dust. (c) Estimated.

The world's total in 1929 was 1,621,222 tons, an average of 135,102 tons a month, out of which Belgium, Poland, and The Netherlands accounted for 434,982 tons, an average of 36,249 tons a month. Since 1929 the monthly production of the three countries named has not been reported.

Average Metal Prices for September, 1930

COPPER:	
Electrolytic, refinery	10.310
London Standard Spot	46.264
London Electrolytic Spot	49.500
LEAD:	
New York	5.500
St. Louis	5.348
London Spot	17.909
London Forward	17.798
SILVER:	
New York	36.315
London	16.738
Sterling Exchange	485.888
ZINC:	
St. Louis	4.270
London Spot	15.773
London Forward	16.080
TIN:	
Straits	29.647
London Standard Spot	132.631
QUICKSILVER	113.620
ANTIMONY	7.773
PLATINUM:	
Refined	36.080
ALUMINUM 99 Per Cent Plus	23.300

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Eagle-Picher Negotiating for Commerce Mining

Negotiations for the purchase of the mining properties of Commerce Mining & Royalty in the Tri-State district by Eagle-Picher Mining & Smelting have progressed to the point where an option will be granted, or has been granted, according to well-authenticated reports. However, officials of both companies deny that any papers have been signed. Arthur E. Bendelari, of Chicago, president of Eagle-Picher Lead; attorneys for the company, and other officials of the company were in the district recently and were known to have conferred with G. L. Coleman, president of Commerce, and John Robinson and C. M. Harvey, of El Paso, Tex., who represent the remaining owners of the Commerce company.

The property of the Commerce company includes eight active mines, a dozen idle plants, leases on more than 2,500 acres of mining land in the Oklahoma and Kansas sections of the Tri-State district, a central power plant, a central air-compressor station, central blacksmith shop, the Producers Supply Company, miscellaneous royalty interests, some fee land and some holdings in Miami, all of which are variously estimated to be worth from $6,000,000 to $18,000,000, the latter being the figure at which the Anaconda Copper option on the properties a year ago was said to have been given.

Acquisition of these properties would make Eagle-Picher one of the largest producers of zinc concentrate in the United States and give it a much-needed supply of lead concentrates for its local smelters. Eagle-Picher would assume a position in the Tri-State mining industry comparable with the position of the United States Steel Corporation in the steel industry and would make it possible for the local industry to have a company with sufficient prestige to sustain a much-needed leadership in the industry that would tend immeasurably toward stabilizing the local mining industry as well as that of the United States.

The Commerce company is producing about 1,500 tons of zinc concentrates a week, and at the present rate of shipments will deliver to smelters in 1930 about 75,000 tons of zinc concentrates, the largest single company delivery in the history of the field. The company is at present in the midst of a reorganization campaign that will make it possible for it to produce close to 2,500 tons of zinc concentrates a week before the end of the year, if needed.

Eagle-Picher will ship about 25,000 tons of zinc concentrates in 1930, and Consolidated Lead & Zinc, a subsidiary of Eagle-Picher, will ship about 20,000 tons. The combined estimated shipments of the three companies for 1930 will be about 115,000 tons of zinc concentrate, or more than 25 per cent of the district's estimated 1930 shipments. The zinc production of Eagle-Picher in 1930, plus the output of the Commerce company, will be equal to one-tenth of the production of that metal in the United States for the year.

Commerce is owned by G. L. Coleman, Mrs. Catherine Robinson, widow of the late J. F. Robinson; her three children (Mrs. Lillie O. Willis, John Robinson, and Mrs. Gladys Youse), and C. M. Harvey, of El Paso, Tex. Eagle-Picher Mining & Smelting is the recently formed mining and smelting subsidiary of the Eagle-Picher Lead Company. Besides the mining properties in the Tri-State district, the company owns lead smelters at Galena, Kan., and Ontario, Okla., and the zinc smelter at Henryetta, Okla.

World's Lead Production in August Slightly Higher

World production of lead during August registered a moderate increase over the record for July, reflecting a gain in output by both Germany and the United States. The total output of 154,164 tons for August compares with 151,356 tons in July, and a monthly average of 154,045 tons for the first eight months of the current year, according to the American Bureau of Metal Statistics. The daily rate for August was 4,973 tons, against 4,882 tons in July, and 5,018 tons in June.

The statistics of world lead production, compiled on a refined lead basis, in tons, follow:

	June	July	August
United States	50,721	51,538	52,980
Canada	12,789	13,066	13,303
Mexico	21,110	22,661	22,563
Peru	1,666	1,261	1,070
Germany	10,938	9,140	11,235
Italy	2,276	2,643	1,806
Spain and Tunis (a)	9,354	9,018	9,163
Europe (b)	18,100	18,300	18,300
Australia	14,943	15,227	15,242
Burma	7,444	7,302	7,302
Elsewhere (c)	1,200	1,200	1,200
Totals	150,541	151,356	154,164

(a) Incomplete. (b) European countries not specified elsewhere. (c) Estimated or partly estimated.

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No Silver From China or India

No silver was imported into the United States from China or India in the months of July and August.

Total imports from all countries of silver ore and base bullion amounted in August to 6,017,234 oz., valued at $2,143,805, compared with July imports of 5,911,794 oz., valued at $2,157,688. August imports of refined bullion totaled 3,294,090 oz., valued at $1,155,948, compared with imports in July of 4,266,372 oz., valued at $1,463,477. Coin imports in August amounted to $124,721 U. S. and $68,000 foreign. July imports totaled, respectively, $127,676 and $203,901.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.& M.M.*, 36th St. and 10th Ave., N.Y.City.

Copper Price Reduced to 10c.—Lead Down on Weakness in London—Tin and Zinc Easy

New York, Oct. 2, 1930.—The trend of prices in the major metals was downward in the last two weeks. Trade returns for September were disappointing, and buyers could not be induced to make commitments except at the expense of prices. Interest centered in the action of copper, the price of which fell to 10c., delivered Connecticut, the lowest price since 1896. The lower market for copper brought out some good buying, foreign as well as domestic. Lead went off in price to the extent of 15 points, under pressure of selling in London. Tin prices showed a net loss for the period of almost 2c., notwithstanding a decline in the world's visible supply. Zinc came out more freely toward the close, due largely to the unsettlement in other metals. Silver was fairly steady. Demand for quicksilver was dull and prices quoted were largely nominal.

Good Copper Sales at 10c.

The price of copper registered a net loss in the last two weeks of ½c., the market settling with all sellers asking 10c. per pound, delivered Connecticut. The reduction in price was not made in one fell swoop, but gradually, with custom smelters taking the initiative so as to dispose of their current intake. A good volume of business was booked on the decline, though some sellers had to include first quarter of 1931 copper on contracts closed. Most of the fabricators who took on copper in a large way at 10c. were heavy buyers when the price dropped to 11½c. last July, and again when the 11c. basis was reached.

Production of copper is expected to show another decline as a result of the present low selling basis. All of the Lake copper producers have taken steps in the last month or so to effect a further cut in output. A possible tariff on copper is mentioned frequently in producing circles, though action in this direction is not likely to take form for some time.

Export demand for copper during September was disappointing, total sales amounting to about 25,000 long tons. Copper Exporters, Inc., reduced the price on Sept. 30 to 10.30c., c.i.f. European ports. Foreign demand improved at the lower price and promises to absorb a good tonnage.

Lead Price Lowered

The price of lead was reduced on Oct. 1 to 5.35c., New York, the contract basis of the American Smelting & Refining Company, and 5.20c., St. Louis, a decline of 15 points. Continued weakness in the London market, which sent the price there to the New York equivalent of 5.36c. on three-month contracts, was directly responsible for the reduction in the domestic selling basis. The unsettled foreign situation caused most buyers here to restrict new business to a minimum. Domestic shipments of lead during September held at a good level, considering the general slump in business, and with production well in hand, the situation here is far more favorable than abroad. The decline in London in copper, zinc, and tin had a depressing influence on lead. Quite a little of the selling in London was credited to Continental operators.

(Just before going to press the contract basis for common lead was reduced by the A. S. & R. to 5.25c. per pound, New York, effective Oct. 4. The leading seller in St. Louis reduced his price to 5.10c.)

Zinc Unsettled

Demand for zinc fell off sharply toward the close. The inactivity of buyers was due in part to the fact that they contracted for a good tonnage earlier in the period. The decline in the general list of major metals spread to zinc, though to a limited extent only. Most of the business booked in the last fortnight was at 4.25c., St. Louis. Shortly before the close offerings appeared on the market at 4.225c., with intimation that this figure might be shaded in some quarters. The London market made a new low, spot zinc on Oct. 1 closing at £14 10s.

Zinc concentrate in Joplin sold at $30 per ton for Prime, basis 60 per cent.

Tin Lower

The general weakness in the other metals brought out liquidation in London tin, which sent the price here down to 28c., a net decline for the period of close to 2c. per pound. There was some good buying on the decline by American consumers. In view of the improved statistical position of the market, the world's visible supply actually showing a moderate reduction for the first time in many months, the pressure to sell came most unexpectedly. Straits shipments in September totaled 5,308 long tons, against 7,849 tons in the preceding month, and 6,608 tons in September of last year. Total deliveries for the month were 11,170 long tons, against 9,888 tons in August, and 12,498 tons in September, 1929. The total visible supply at the close of September stood at 40,150 long tons, against 43,805 tons in August, and 24,556 tons in September, 1929. The average price of Straits tin in New York for September was 29.647c. per pound, which compares with 45.359c. for the same month last year.

Silver in Firmer Hands

The monthly average price of silver showed a moderate gain in September. Selling pressure virtually disappeared, indicating that the metal is now in firmer hands. The exchange situation in the Far East has improved somewhat, which was reflected in a fair demand for silver from China. World production of silver is expected to point downward over the remainder of the year, owing chiefly to the smaller output of major metals.

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, unchanged, at 23.30c. for 99 and 98 per cent grades.

ANTIMONY — Per lb., duty paid, Chinese spot, 7½c.; futures, 7⅜c. Cookson's "C" grade, spot, 12⅞c. "C.M.C." grade, 99.9 per cent, spot, 10¾c.

BISMUTH—Per lb., $1. London, 4s.

CADMIUM—Per lb., 70c.

IRIDIUM — Per oz., $190@$200 for 98@99 per cent sponge and powder. London, £37@£39.

NICKEL — Per lb., ingot and electrolytic (99.9 per cent), 35c. for single lots of spot metal. Contracts less. Shot, 36c.

PALLADIUM — Per oz., $22@$23. London, £3 15s. to £4.

PLATINUM—Per oz., official price of leading interest advanced from $34 to $36 on Sept. 22. Selling pressure has disappeared and tone of market is quite firm. Cash transactions between dealers and refiners at several dollars less. London quotes £6 15s. per oz., with outside lots available at concessions.

QUICKSILVER—Per 76-lb. flask, $110 @$115. Offerings fairly liberal, and with business dull prices are little more than nominal.

RHODIUM—Per oz., $50. Nominal.

RUTHENIUM—Per oz., $45@$50.

Chromium, Cobalt, Magnesium, Manganese, Molybdenum, Osmium, Radium, Selenium, Silicon, Tantalum, Tellurium, Thallium, and Tungsten are unchanged from prices given in the Sept. 25 issue.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

CHROME ORE — Per long ton, f.o.b. Eastern shipping points, Indian ores, 46 to 48 per cent Cr_2O_3, $19.50. Other prices in Sept. 25 issue.

IRON ORE — Per unit, foreign ores alongside docks Atlantic ports, cargo lots, North African and Swedish, low phosphorus, 10½c.; Spanish and North African basic, 50 to 60 per cent, 9@9½c. Other prices in Sept. 25 issue.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty of 1c. per lb. of Mn contained, Indian, 48 to 50 per cent,

Daily Prices of Metals

Sept. Oct.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
18	10.275	29.80	5.50	5.35	4.25
19	10.275	29.65	5.50	5.35	4.225@4.25
20	10.275	29.65	5.50	5.35	4.25
22	10.025@10.275	29.35	5.50	5.35	4.25
23	10.025@10.275	29.80	5.50	5.35	4.25
24	10.025	29.75	5.50	5.35	4.25
Av'ge	10.192	29.667	5.500	5.350	4.248
25	10.025	29.50	5.50	5.30@5.35	4.25
26	9.775@10.025	29.20	5.50	5.35	4.25
27	9.775@10.025	29.25	5.50	5.35	4.25
29	9.775	28.75	5.50	5.35	4.225@4.25
30	9.775	28.70	5.50	5.35	4.225@4.25
1	9.775	28.00	5.35	5.125@5.20	4.225@4.25
Av'ge	9.858	28.900	5.475	5.315	4.244

Average prices for calendar week ended September 20, 1930: are Copper, 10.279c.; Straits tin, 29.796c.; New York lead, 5.500c.; St. Louis lead, 5.346c.; Zinc, 4.248c.; and Silver, 36.646c.

Average prices for calendar week ended September 27, 1930: are Copper, 10.025c.; Straits tin, 29.475c.; New York lead, 5.500c.; St. Louis lead, 5.346c.; Zinc, 4.250c.; and Silver, 36.667c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver		Gold London	Sept. Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
18	4.85 15/16	37	17	85s00 1/2d	25	4.85 13/16	36 5/8	16 7/8	85s00 1/4d
19	4.85 1/4	36 3/4	16 15/16	85s00 3/4d	26	4.85 1/8	36 1/2	16 3/4	85s00 1/4d
20	4.85 1/8	36 5/8	16 13/16	.....	27	4.85 1/2	36 3/8	16 3/4	.....
22	4.85 1/2	36 7/8	17	85s00 3/4d	29	4.85 11/16	35 7/8	16 5/8	84s11 3/4d
23	4.85 5/8	36 7/8	17	85s00 3/4d	30	4.85 1/2	35 1/2	16 3/8	84s11 1/2d
24	4.85 3/4	36 3/4	16 7/8	85s00 1/4d	1	4.85 11/16	35 1/2	16 3/8	84s11 3/4d

Average of week ended September 24: Silver, 36.813c.; Sterling Exchange, $4.85771.
Average of week ended October 1: Silver, 36.063c.; Sterling Exchange, $4.85719.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-sixteenths cent premium.

London

Sept. Oct.	Copper Standard		Electrolytic	Tin		Lead		Zinc	
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
18	46 1/4	46 3/16	49	134	135 5/8	17 5/8	17 1/2	15 13/16	16 1/8
19	45 11/16	45 11/16	49	133 1/2	135	17 5/8	17 1/2	15 13/16	16
22	45 3/16	45 1/8	49	132	133 5/8	17 13/16	17 5/8	15 13/16	15 7/8
23	45 1/4	45 3/8	49	131 3/4	133 1/2	17 3/4	17 1/2	15 1/2	15 5/8
24	45 1/4	45 3/16	49	132 1/2	134 1/4	17 3/4	17 9/16	15 1/2	15 5/8
25	45 1/16	45 1/16	48 1/2	131 3/8	132 7/8	17 7/8	17 3/4	15 3/8	15 1/2
26	44 1/2	44 9/16	48 1/2	130 1/2	132 1/2	17 11/16	17 7/16	15 1/4	15 3/8
29	43 3/8	43 3/8	47	127 7/8	129 1/2	16 3/4	16 5/8	15	15 1/4
30	43 1/2	43 7/16	46 1/2	125 1/4	126 1/4	16 3/4	16 1/2	14 3/4	14 7/8
1	43 7/8	43 3/4	46 1/2	125	126 3/8	16 7/16	16 1/4	14 1/2	15 1/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

27@28c.; South African, 52 to 54 per cent, 27@28c. Nominal.

Chemical grades, per ton, in carload lots, powdered, coarse, or fine, $60, f.o.b. mines, or Atlantic ports.

TUNGSTEN ORE — Per unit of WO_3, New York: Chinese wolframite, duty paid, $12.25@$12.50. Bolivian scheelite, $13; domestic scheelite, $13@$14; both nominal.

Antimony, Beryllium, Molybdenum, Tantalum, Tin, Titanium, Vanadium, and Zircon ores are unchanged from prices given in the Sept. 25 issue.

Non-Metallic Minerals

FLUORSPAR—Per ton, f.o.b. *Colorado*, not less than 82 per cent CaF, and not over 5 per cent SiO_2, $12.75. Other fluorspar prices in Sept. 25 issue.

Quotations for other non-metallic minerals are unchanged from those published in the issue of Sept. 25.

Alloys

Alloy prices are unchanged from those given in the Sept. 25 issue.

Metallic Compounds

Prices given for metallic compounds in the Sept. 25 issue are unchanged.

Refractories

Refractories are unchanged from the prices given in the Sept. 25 issue.

Rolled Metals

COPPER — Per lb., sheets, hot-rolled, 19¾c. nominal; wire, f.o.b. mill, 11¾c.

LEAD SHEETS—Per lb., full rolled, 8¼c.; clipped, 8½c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 16½c.; plates, 19c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER — Per lb., sheets, 10 per cent, 24⅜@24⅞c.; 18 per cent, 27⅝@28⅛c. Wire and rods, 10 per cent, 27⅛c. 15 per cent, 31⅝c.; 18 per cent, 35⅛c.

PHOSPHOR BRONZE — Per lb., sheets and rods, 5 per cent tin, 31⅛c.; wire, 5 per cent, 31⅜c.; 10 per cent, 37⅛c.

ZINC SHEETS — Per lb., 9½c., f.o.b. works; ribbon, 9c.; 7 per cent discount on orders for 18 tons or more.

Iron, Steel, and Coke

IRON — Per gross ton, Valley furnaces: Bessemer, $18; basic, $17; No. 2 foundry, $17.50.

STEEL — Per gross ton, base prices. Pittsburgh, billets and slabs, $31; plates and structural shapes per 100 lb., $1.60; soft steel bars, $1.60@$1.65.

COKE — Per ton, Connellsville furnace, $2.60. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $5.50; Buffalo, $8@$8.50; Detroit, $8.50; Birmingham, $5.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1929	1930	1929	1930	1929	1930
January	57.019	45.000	26.257	20.896	484.577	486.447
February	56.210	43.193	25.904	20.008	484.787	485.784
March	56.346	41.654	26.000	19.298	484.776	485.933
April	55.668	42.428	25.738	19.554	484.808	486.019
May	54.125	40.736	25.084	18.850	484.599	485.724
June	52.415	34.595	24.258	16.049	484.330	485.625
July	52.510	34.346	24.289	15.928	484.560	486.300
August	52.579	35.192	24.288	16.283	484.368	486.839
September	51.042	36.315	23.708	16.738	484.253	485.888
October	49.913	.....	23.042	.....	486.392	.....
November	49.615	.....	22.690	.....	487.104	.....
December	48.475	.....	22.258	.....	487.523	.....
Year	52.993	.....	24.460	.....	485.173	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery		London Spot			
	Electrolytic		Standard		Electrolytic	
	1929	1930	1929	1930	1929	1930
January	16.603	17.775	75.551	71.469	78.602	83.250
February	17.727	17.775	78.228	71.419	83.538	83.500
March	21.257	17.775	89.153	69.202	98.356	83.405
April	19.500	15.621	81.036	62.075	89.405	74.338
May	17.775	12.756	75.026	53.159	83.727	59.545
June	17.775	12.049	74.338	50.003	84.013	56.750
July	17.775	11.023	72.152	48.277	84.043	52.522
August	17.775	10.693	73.783	47.525	84.250	50.725
September	17.775	10.310	75.286	46.264	84.363	49.500
October	17.775	.....	72.815	.....	83.978	.....
November	17.775	.....	69.324	.....	82.202	.....
December	17.775	.....	68.303	.....	82.569	.....
Year	18.107	.....	75.416	.....	84.921	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1929	1930	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.650	6.250	6.498	6.100	22.111	22.344	21.545	21.571
February	6.853	6.236	6.739	6.086	23.128	23.156	21.188	21.097
March	7.450	5.662	7.348	5.542	25.409	25.591	18.807	18.940
April	7.187	5.537	7.025	5.428	24.783	24.408	18.319	18.363
May	7.000	5.523	6.761	5.408	23.949	23.750	17.795	17.861
June	7.000	5.410	6.790	5.310	23.694	23.603	17.941	17.994
July	6.804	5.250	6.607	5.149	22.810	22.880	18.160	18.063
August	6.750	5.488	6.553	5.340	23.185	23.259	18.294	18.178
September	6.890	5.500	6.689	5.348	23.557	23.589	17.909	17.798
October	6.873	.....	6.674	.....	23.226	23.253	.....	.....
November	6.285	.....	6.135	.....	21.622	21.643	.....	.....
December	6.250	.....	6.100	.....	21.472	21.484	.....	.....
Year	6.833	.....	6.660	.....	23.246	23.247	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1929	1930	1929	1930
	Straits		Spot	
January	49.139	38.851	222.727	175.466
February	49.347	38.676	223.138	173.750
March	48.870	36.798	220.781	164.851
April	45.858	36.077	206.887	162.638
May	43.904	32.108	197.545	144.818
June	44.240	30.336	200.206	136.300
July	46.281	29.822	209.473	134.511
August	46.619	30.044	209.815	134.988
September	45.359	29.647	204.863	132.631
October	42.290	.....	190.783	.....
November	40.208	.....	180.565	.....
December	39.745	.....	179.419	.....
Year	45.155	.....	203.850	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.350	5.229	26.196	26.233	19.634	20.241
February	6.350	5.180	26.247	26.347	19.209	19.778
March	6.463	4.934	27.050	27.294	18.304	18.810
April	6.658	4.843	26.759	26.613	17.819	18.378
May	6.618	4.641	26.727	26.619	16.639	17.324
June	6.686	4.441	26.216	25.984	16.422	17.038
July	6.766	4.350	25.332	25.418	16.171	16.777
August	6.800	4.360	24.896	25.164	15.953	16.469
September	6.799	4.270	24.208	24.688	15.773	16.080
October	6.740	.....	22.927	23.329	.....	.....
November	6.242	.....	20.851	21.351	.....	.....
December	5.666	.....	20.072	20.672	.....	.....
Year	6.512	.....	24.790	24.976	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1929	1930	1929	1930	1929	1930
January	9.558	8.606	119.481	121.192	70.000	61.923
February	9.548	8.830	119.818	120.500	70.000	59.909
March	9.531	8.236	121.904	118.808	70.000	54.769
April	9.462	7.740	122.000	114.000	70.000	46.462
May	8.957	7.454	121.154	117.269	68.615	46.000
June	8.845	7.057	120.500	118.600	68.000	46.000
July	8.543	6.976	121.654	117.462	68.000	43.692
August	8.778	7.839	125.111	116.700	68.000	41.462
September	8.709	7.773	124.542	113.620	66.000	36.080
October	8.538	.....	124.298	.....	65.000	.....
November	8.583	.....	123.323	.....	65.000	.....
December	8.420	.....	121.950	.....	63.240	.....
Year	8.956	.....	122.145	.....	67.655	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1929	1930	1929	1930	1929	1930	1929	1930
Jan	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
Feb	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
March	18.19	19.00	17.62	18.50	17.69	18.50	24.300	24.300
April	18.50	19.00	18.00	18.50	18.00	18.50	24.300	24.300
May	18.81	19.00	18.31	18.50	18.31	18.50	24.300	24.300
June	19.00	19.00	18.50	18.50	18.50	18.50	24.300	24.140
July	19.00	18.62	18.50	18.12	18.50	18.12	24.300	23.300
Aug	19.00	18.50	18.50	18.00	18.50	18.00	24.300	23.300
Sept	19.00	18.38	18.50	17.76	18.50	17.88	24.300	23.300
Oct	19.00	.....	18.50	.....	18.50	.....	24.300	.....
Nov	19.00	.....	18.50	.....	18.50	.....	24.300	.....
Dec	19.00	.....	18.50	.....	18.50	.....	24.300	.....
Year	18.71	.....	18.20	.....	18.21	.....	24.300	.....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

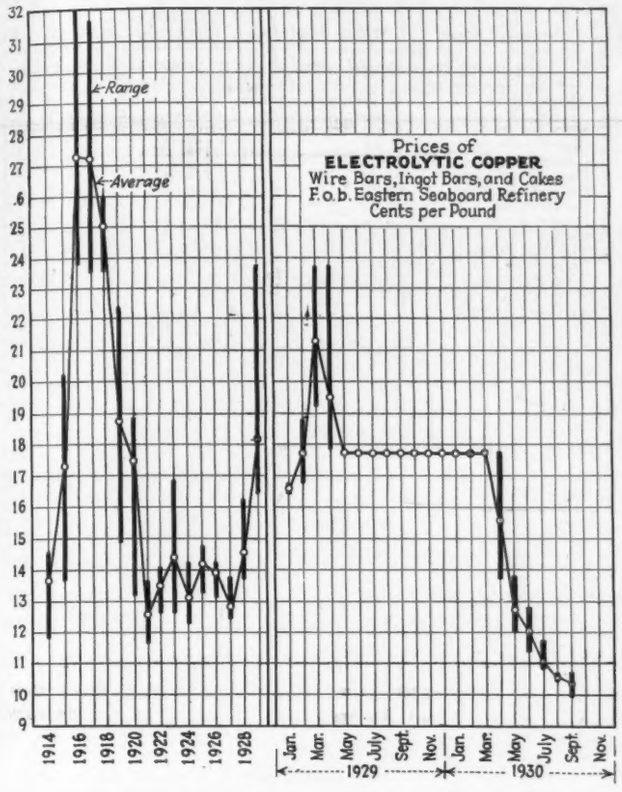
	1929	1930				
	Total	April	May	June	July	Aug.
Domestic						
Alaska shipments	21,947	1,416	1,052	1,250	1,673	486
Calumet & Arizona	65,246	3,752	3,799	3,939	3,767	3,758
Magma	19,118	1,309	1,556	1,150	674	1,494
Miami	29,567	2,762	2,984	2,893	2,675	3,035
Nevada Cons	133,140	.....	.....	(d) 17,870	.....	.....
Old Dominion(a)	11,172	1,045	964	845	722	929
Phelps Dodge	111,026	6,034	6,049	6,037	5,755	6,262
United Verde Extens	29,669	2,047	2,007	1,790	1,949	2,014
Utah Copper	148,312	.....	.....	(f)	.....	.....
Tennessee Copper	7,870	653	676	596	615	622
Foreign						
Andes Copper	83,718	4,155	3,945	3,936	.....	.....
Braden	88,155	4,610	4,620	5,818	.....	.....
Boleo, Mexico	13,196	.....	.....	(d) 3,636	.....	.....
Bwana M'Kubwa	6,988	525	489	501	551	598
Chile	150,247	7,489	7,483	7,486	.....	.....
Furukawa, Japan	17,767	1,542	1,625	1,511	1,413	.....
Granby, Cons., Canada	30,424	1,891	2,063	2,204	2,066	2,330
Howe Sound	21,516	.....	.....	(d) 5,698	.....	.....
Messina	(e) 7,200	576	718	729	711	734
Mt. Lyell	7,600	.....	.....	(d) 2,090	.....	.....
Sumitomo, Japan	20,180	1,404	1,644	1,687	1,666	.....
Union Minière, Africa	151,006	.....	.....	(e) 72,800	.....	.....

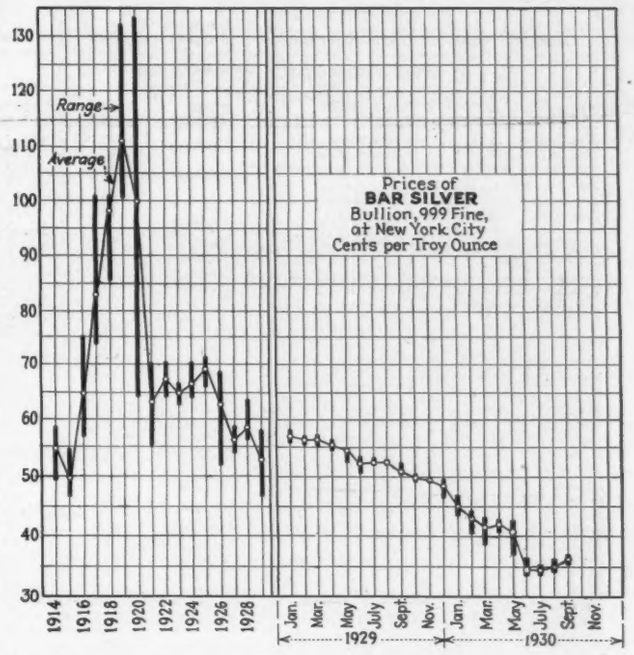
(a) Includes Arizona Commercial. (b) Moctezuma is included. (c) Estimated. (d) Three months. (e) Six months. (f) Not reported.

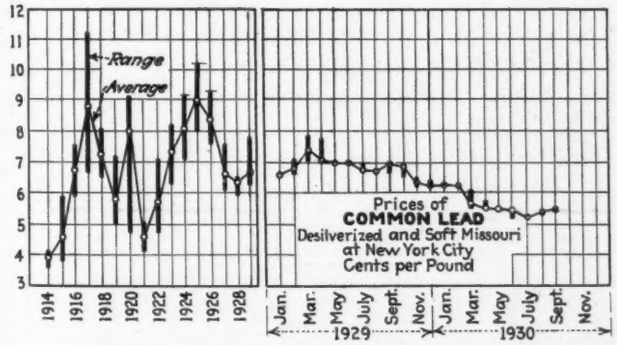
Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

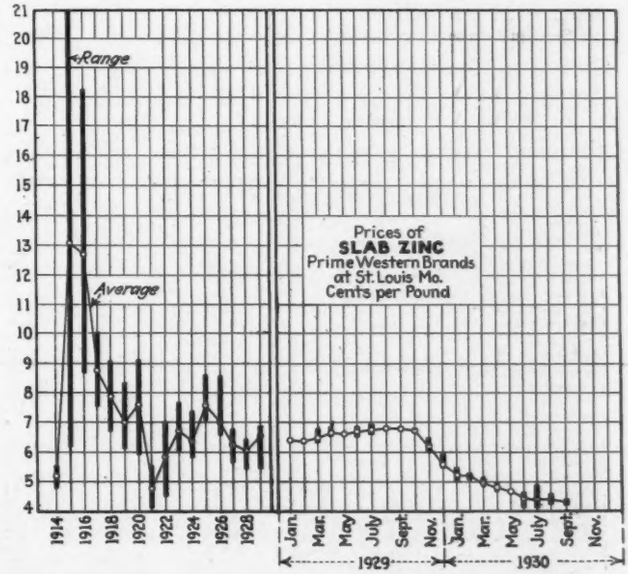
	1928		1929		1930	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	68,469	2,209	86,324	2,785	67,838	2,188
February	67,423	2,352	84,735	3,026	59,196	2,114
March	70,327	2,269	93,698	3,023	61,216	1,975
April	69,721	2,324	94,902	3,163	60,450	2,015
May	73,729	2,378	93,392	3,013	60,238	1,943
June	73,224	2,441	82,354	2,745	56,743	1,891
July	73,426	2,369	79,229	2,556	54,249	1,750
August	76,952	2,482	78,885	2,545	56,779	1,832
September	78,341	2,611	79,402	2,647	.....	.....
October	86,480	2,790	82,575	2,664	.....	.....
November	85,382	2,846	75,934	2,531	.....	.....
December	85,677	2,764	74,772	2,412	.....	.....
Total	909,051	.....	1,006,203	.....	476,709	.....
Monthly average	75,754	.....	83,850	.....	59,589	.....
Av. of daily rate	.....	2,484	.....	2,757	.....	1,962

Metal Price Curves

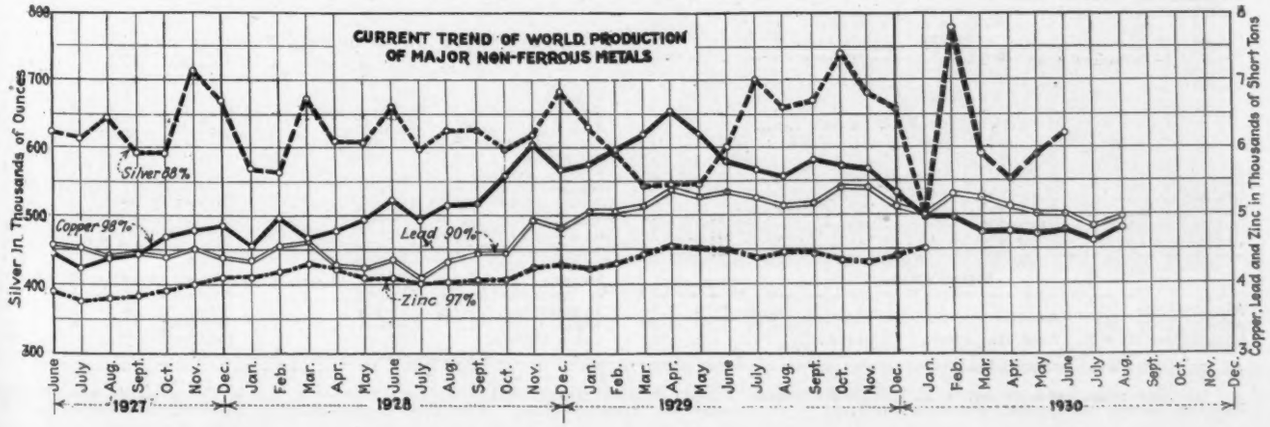








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The zinc curve has not been plotted for the past months of 1930, owing to the absence of some European production statistics; this situation is believed to be only temporary in character. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver In Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88%
Copper 98%
Lead 90%
Zinc 97%
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1927
1928
1929
1930

Mining Share Prices—Month of September, 1930

Company Name	Metals Produced	Location of Properties	High	Low	Last
NEW YORK STOCK EXCHANGE					
Ahumada Lead	Lead silver	Mexico	0.75	0.50	0.50
Alaska Juneau	Gold	Alaska	6.25	4.87½	5.00
Am. Metal	Lead, silver, zinc	Various	31	21¼	22
Am. Metal, pfd	Copper, gold	Various	106	102	102
Am. Sm. & Ref	Lead, copper, silver	Various	71½	51	53
Am. Sm. & Ref., 2d pfd		Various	103	101	101
Am. Sm. & Ref., pfd	Gold, zinc		140	135	135
Am. Zinc., L. & S	Zinc, lead	Various	10¾	6.75	7.00
Am. Zinc, L. & S., pfd		Various	62	52½	52½
Anaconda	Copper, zinc, silver	Various	49½	34¼	35¾
Andes Copper	Copper, silver	Chile	22½	16	16
Butte C. & Z	Manganese, zinc	Montana	2.37½	2.00	2.00
Butte & Superior	Zinc, silver	Montana	1.62½	1.25	1.25
Callahan Zinc-Lead	Lead, zinc	Idaho	1.12½	0.87½	0.87½
Cal. & Arizona	Copper, gold, silver	Arizona	52¼	43	43½
Cal. & Hecla	Copper	Michigan	14¼	10	10½
Cerro de Pasco	Copper, silver, lead	Peru	48	37⅛	37⅛
Dome Mines	Gold	Ontario	10¾	8.00	8.00
Federal M. & S	Lead, zinc, silver	Idaho,	126½	120	126½
Federal M. & S., pfd		Tri-State			100½*
Freeport Texas	Sulphur	Texas	47⅜	39	39½
Granby Con	Copper, silver, gold	Brit. Col.	23¼	13¾	15
Greene Cananea	Copper, silver, gold	Mexico	66	55	55
Homestake	Gold	So. Dakota	83	79	80
Howe Sound	Copper, lead, zinc	Various	31½	24	24½
Inspiration	Copper	Arizona	15½	9.25	9.87½
International Nickel	Nickel, copper	Ontario	27⅜	19¼	19¾
Int. Nickel, pfd			121½	120⅜	121
Kennecott	Copper, gold, silver	Various	38⅜	27¼	27½
McIntyre-Porcupine	Gold	Ontario	19½	17⅛	18
Magma Copper	Copper, silver, gold	Arizona	32⅜	26¼	26½
Miami Copper	Copper	Arizona	15⅝	10	10
Mother Lode	Copper, silver	Alaska	1.25	0.87½	0.87½
National Lead	Lead, zinc	Various	136½	119	120
National Lead, pfd. A			144	141¼	142
National Lead, pfd. B			119⅞	118	118½
Nevada Con	Copper, gold, silver	Various	16⅞	10⅜	10⅜
Park Utah Con	Zinc, silver, lead	Utah	2.00	1.50	1.75
Patiño M. & E	Tin	Bolivia	16⅛	9.12½	10½
Phelps Dodge	Copper, gold, silver	Various	32¼	28	29
Rand Mines	Gold	Africa	34	32	32
St. Joseph Lead	Lead, zinc, silver	Various	41½	34	34½
Seneca Copper	Copper	Michigan	3.00	1.50	1.75
Tennessee C. & C	Copper, su. acid	Tennessee	12	8.75	9.00
Texas Gulf	Sulphur	Texas	60½	53½	54⅜
U. S. S. R. & M	Silver, gold, lead	Various	22½	17½	17½
U. S. S. R. & M., pfd	Zinc, copper		47	45	45
Utah Copper	Copper, gold, silver	Utah	148	148	148
Vanadium Corp	Vanadium, ilmenite	Various	90	56½	57½
NEW YORK CURB EXCHANGE					
Aluminum Co. of Am.	Aluminum	Various	239	185	190
Alum. Co. of Am.,pfd.			111⅜	109½	109⅜
Anglo-Chilean Con	Nitrate	Chile	29½	19½	19½
Bunker H. & S	Lead, silver, zinc	Idaho			70*
Carnegie Metals	Silver, gold	Mexico	7.37½	6.00	6.00
Con. Coppermines	Copper, gold, silver	Nevada	3.87½	2.00	2.25
Copper Range	Copper	Michigan	8.75	8.00	8.00
Cresson Con	Gold	Colorado	0.31½	0.25	0.31½
Cusi Mexicana	Lead, zinc, silver	Mexico	0.75	0.50	0.50
Evans-Wallower	Lead, zinc	Various	2.12½	1.62½	1.62½
Federated Metals	Trading	Various	15	13	13
Hecla Mining	Lead, silver, zinc	Idaho	10½	9.00	9.50
Hollinger Con	Gold	Ontario	6.50	5.75	6.00
Hudson Bay M. & S	Copper, zinc	Manitoba	8.37½	5.12½	5.87½
Iron Cap Copper	Copper, silver, gold	Arizona	1.62½	1.50	1.50
Mayflower Assoc	Holding	Various	60½	50	50
Mining Corporation	Silver, lead, zinc	Canada	1.00	0.87½	0.87½
New Jersey Zinc	Zinc, lead, silver	Various	65½	64½	65
Newmont Mining	Holding, copper, gold	Various	88⅝	73	73
N. Y. and Honduras	Silver, gold	Honduras	9.50	9.50	9.50
Nipissing	Silver	Ontario	1.37	1.00	1.00
Noranda Mines	Copper, gold, silver	Quebec	24½	17½	18
Ohio Copper	Copper, lead, gold	Utah	0.50	0.37½	0.37½
Premier Gold	Silver, gold	Brit. Col.	1.12½	0.87½	0.87½
Quincy	Copper	Michigan			15⅜*
Shattuck Denn	Copper, gold, silver	Arizona	4.50	4.00	4.00
So. Am. Gold & Plat	Platinum, gold	Colombia	1.25	1.12½	1.12½
Teck-Hughes	Gold	Ontario	6.87½	6.12½	6.12½
Tonopah Mining	Silver, gold, copper	Various			0.62½*
United Eastern	Silver, lead	Mexico			0.06¼*
United Verde Ex	Copper, gold, silver	Arizona	9.12½	8.50	8.75
United Zinc Sm	Lead, zinc	Tri-State			3.50*
Utah-Apex	Lead, zinc, copper	Utah	2.00	1.50	1.50
Yukon Gold	Gold	Yukon	0.25	0.25	0.25
BOSTON STOCK EXCHANGE					
Ariz. Comm	Copper, gold, silver	Arizona	1.43¾	1.37½	1.37½
East Butte	Copper, gold	Montana	1.12½	0.99	1.06¼
Isle Royale	Copper	Michigan	7.00	5.62½	6.00
Mohawk Mining	Copper	Michigan	25	21	21½
Old Dominion	Copper, gold, silver	Arizona	5.00	3.87½	4.00
Utah Met. & Tunnel	Copper, lead, gold	Utah	0.50	0.40	0.40
MONTREAL					
Asbestos Corp	Asbestos	Quebec	0.75	0.50	0.50
Asbestos Corp., pfd			3.00	3.00	3.00
Consolidated M. & S	Lead, zinc, silver	Canada	191	175	175

Company Name	Metals Produced	Location of Properties	High	Low	Last
TORONTO STANDARD STOCK AND MINING EXCHANGE					
Abana Mines	Copper, zinc, silver	Quebec	0.42	0.30	0.30
Amulet Mines	Copper, zinc, silver	Quebec	0.59	0.40	0.43
Base Metals	Lead, zinc, silver	Brit. Col.	0.15½	0.13	0.13
Barry-Hollinger	Gold	Ontario	2.65	2.00	2.00
Canam Metals	Lead, zinc, silver	Various	0.15	0.14⅜	0.14½
Castle-Trethewey	Silver	Ontario	0.18	0.17	0.17
Central Manitoba	Gold	Manitoba	0.10	0.05	0.07
Falconbridge	Nickel, copper	Ontario	2.55	1.70	1.90
Howey Mines	Gold	Ontario	0.39	0.27	0.28
Keeley	Silver	Ontario	0.28	0.28	0.28
Kirkland Lake	Gold	Ontario	0.68	0.51	0.51
Lake Shore	Gold	Ontario	24¾	22½	23
Sherritt Gordon	Copper, zinc, silver	Manitoba	1.95	1.26	1.40
Siscoe Gold	Gold	Quebec	0.48	0.26	0.40½
Sylvanite	Gold	Ontario	0.46	0.40	0.41
Treadwell Yukon	Lead, zinc, silver	Various	2.75	2.00	2.00
Ventures	Holding	Various	1.05	0.70	0.75
Vipond Con	Gold	Ontario	1.28	1.07	1.08
Waite-A.-M	Copper, zinc, gold	Quebec	3.26	2.00	2.10
Wright-Hargreaves	Gold	Ontario	1.95	1.71	1.85
ST. LOUIS, CINCINNATI, AND DENVER					
Consolidated L. & Z	Lead, zinc	Tri-State	4.00	3.00	3.87
Eagle-Picher	Lead, zinc, silver	Various	8.75	7.50	8.00
Eagle-Picher, pfd			101½	101½	101½
Empire Chief	Lead, zinc, silver	Colorado	0.04½	0.01½	0.02½
New El Paso	Gold	Colorado	0.04½	0.03	0.03½
Star of Utah	Lead, zinc, silver	Utah	0.55	0.40	0.52
Tungsten Production	Tungsten	Colo., Nev.	0.16	0.10	0.12½
SAN FRANCISCO, LOS ANGELES, AND COLORADO SPRINGS					
California Copper	Copper, gold, silver	California	0.87½	0.50	0.75
Golden Cycle	Gold	Colorado	13⅜	12	12
Idaho-Maryland	Gold	California	0.37½	0.25	0.25
Portland	Gold	Colorado	0.01	0.009	0.01
Tom Reed	Gold	Arizona	0.82	0.70	0.82
United Gold	Gold	Colorado	0.07	0.07	0.07
SPOKANE					
Constitution	Lead, zinc, silver	Idaho	0.11¼	0.06	0.06¼
Dayrock	Lead, silver	Idaho	2.00	1.50	1.50
Golconda	Lead, zinc, silver	Idaho	0.53	043½	0.43
Jack Waite Con	Lead, zinc, silver	Idaho	0.06	0.04¾	0.04¾
Mexican Premier	Lead, silver, gold	Mexico	0.32	0.29	0.29
Montana Mines	Gold, silver	Montana	0.36	0.22	0.23
Noble Five	Lead, zinc	Brit. Col.	0.06	0.05	0.05
Pend Oreille	Zinc, silver, lead	Wash	1.00	0.60	0.70
Sherman Lead	Lead, silver	Idaho	0.65	0.50	0.55
Sunshine Mining	Silver, lead, copper	Idaho	2.30	1.97½	2.17
Tamarack & Custer	Lead, silver	Idaho	0.43¼	0.35	0.36
SALT LAKE CITY					
Chief Con	Lead, silver, gold	Utah	1.00	0.90	0.90
Combined Metals	Zinc, lead, silver	Various	0.16	0.13½	0.13½
Eureka Bullion	Lead, silver, gold	Utah	0.27	0.20	0.24
Eureka Lilly	Lead, silver, gold	Utah	0.39½	0.34	0.34½
Moscow Silver	Silver, lead	Utah	0.85	0.70	0.70
New Quincy	Lead, silver, zinc	Utah	0.10	0.04	0.09½
North Lily	Lead, silver, gold	Utah	1.35	1.30	1.30
Park Bingham	Lead, zinc, silver	Utah	0.04	0.03½	0.04
Park City Con	Lead, zinc, silver	Utah	0.32	0.29½	0.29½
Rico Argentine	Zinc, lead, silver	Colorado	0.08¾	0.07	0.07
Silver King Coal	Lead, silver, zinc	Utah	7.45	6.60	6.60
Tintic Lead	Lead, silver, copper	Utah	1.25	1.10	1.10
Tintic Standard	Lead, gold, silver	Utah	5.55	5.00	5.00
Walker Mining	Copper, gold, silver	California	2.20	1.80	1.80
‡LONDON					
Anglo American	Holding	Various	20/6	15/—	19/4½
Aramayo Mines	Tin, bismuth, silver	Bolivia	23/9	22/9	23/9
Burma Corporation	Lead, silver, zinc	India	12/3	10/4½	11/1½
Bwana M'Kubwa	Copper	Rhodesia	13/6	10/6	12/—
Camp Bird	Holding	Various	7½d.	6d.	7½d.
Fresnillo	Silver, lead, zinc	Mexico	8/9	8/9	8/9
Frontino & Bolivia	Gold	Colombia	8/3	7/6	8/3
Lake View & Star	Gold	Australia	11/3	8/9	9/7½
Mexican Corporation	Copper, zinc	Mexico	5/3	4/6	5/—
N'Changa Copper	Copper	Rhodesia	74/4½	60/7½	65/—
Oroville Dredging	Gold	California	1/7½	1/4	1/6
Rhodes. Congo Border	Copper	Rhodesia	292/6	270/—	272/6
Rhodes.-Select. Trust	Copper	Rhodesia	30/—	26/—	28/—
Rio Tinto	Copper, pyrites	Spain	733/9	675/—	710/—
St. John del Rey	Gold	Brazil	18/1½	16/6	17/9
San Francisco Mines	Zinc, lead, silver	Mexico	17/3	14/—	16/3
Santa Gertrudis	Silver, gold	Mexico			7/9*
Selukwe	Holding	Africa	4/1½	2/3	3/1½
So. American Copper	Copper	Venezuela	1/4½	1/0½	1/1½
Tanganyika	Holding	Africa	35/—	25/9	33/1½
Wiluna Gold	Gold	Australia	17/6	16/—	16/6
Union Minière	Copper	Bel.Congo	7,525	6,775	7,500†

Salt Lake Stock Exchange courtesy J. A. Hogle & Company, Toronto Standard Stock Exchange courtesy the Arthur E. Moysey Company, Spokane Standard Exchange courtesy the Pohlman Investment Company. *Not traded in. †Belgian Francs. ‡The above London quotations are for the month ended Sept. 19.